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Mysore Agricultural
and
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The Mysore Agricultural and Experimental Union.†

BY

Dr. Leslie C. Coleman, M.A., Ph.D.,
Director of Agriculture in Mysore.

It is hard for me to realize that it is eleven years since the Mysore Agricultural and Experimental Union held its first Annual Meeting and I look back over the intervening years with somewhat mixed feelings. The Union has certainly not become the potent force in the development of Mysore agriculture which I had hoped it would become. On the other hand, the Union has undoubtedly stimulated interest in agricultural improvements and has done other useful work.

I might give as an example of this work the formulation of a scheme for agricultural colonies in the State which is at the present moment being used by me as a basis for proposals which I am submitting to Government. I am quite frank to confess that it would not have occurred to me to propose such a scheme and should my proposals be sanctioned by Government and should the scheme prove a success, of both which eventualities I have great hopes, the credit will lie almost entirely with the Mysore Agricultural and Experimental Union. In many other directions the members of the Union have made practical proposals which have been of great use and

* Issued in April 1929.

† Speech at the Eleventh Annual Meeting on the 21st November 1928

although I do not place a very high value on mere discussion, still there is no doubt that our discussions have served a useful purpose in focussing attention on important agricultural problems.

Our Journal has proved a useful means of spreading agricultural knowledge and while it has fallen heavily into arrears during the past two or three years I hope and believe that this will not recur. The renewed publication of the Kannada Journal and its appearance as a monthly is a matter for congratulation. The first number has already been placed in your hands and I believe you will agree that if this standard can be maintained it should prove of real value to our non-English-speaking members and to intelligent agriculturists as a whole.

In this connection may I be permitted to present suggestions to both the Revenue and the Educational Departments of the State ? To the former might I suggest the usefulness of this Journal in both its English and Kannada Editions to Revenue Officers of all grades ? While it is true that Revenue Officers with their many other duties cannot be expected to become agricultural experts, still acquaintance with the more recent work that is being attempted towards agricultural improvement in Mysore and other parts of the world should prove of value to them. To the Educational Department might I suggest that many of the articles which are printed in the Journal might prove useful in connection with the agricultural classes which are being organized in rural schools both as means of instruction for the teachers and as sources for supplemental reading lessons for the pupils.

If we turn to another important phase of the Union's activities, the carrying out of experiments on the land of the members, I am sorry to say that the work so far done has been very disappointing in quantity. No matter how carefully our experimental work is carried out on our departmental farms or in our laboratories we are certain to make serious mistakes in our attempts to introduce improvements unless these results are carefully and extensively tested beforehand on private holdings. One of the most important functions of our district staff is to watch over such tests but until that staff is greatly strengthened work in this direction will be much too meagre. I may say that I hope very shortly to make proposals to Government towards strengthening the connection between the district staff and the

scientific sections in regard to this work but we shall in any case have to be largely dependent upon the self-sacrificing interest of ryots and land-owners if rapid progress in the introduction of improvements is to be attained. I notice that one of our members is moving a resolution with the object of restricting membership to those who actually co-operate with the Agricultural Department in experimental work. I have much sympathy with the object of this resolution and whether it is accepted or not I would most strongly impress upon members that in no other way can they do such useful service for the State's main industry as by co-operating with the Department in these tests.

I should like to turn for a few minutes to a consideration of the important subjects which are down for discussion on our agenda. Of these that dealing with the question of cattle improvement is the one of most immediate importance. Government have in fact asked the Union to furnish their opinion on one aspect of the question of cattle improvement in the State. I have recently had an opportunity of inspecting a number of our Amrut Mahal herds and although they are by no means so pure as they should be, still we have in these herds a legacy of untold value to the State. Whatever may be said by way of criticism of the Amrut Mahal Department and its work in the past, we must not forget that that Department has preserved for us one of the outstanding breeds of Indian cattle in a state of purity that can be equalled nowhere else in India. I had recently an opportunity to show some of the best of our herds to the Imperial Dairy Expert—a man who has probably a wider knowledge of the Indian breeds of cattle than any one else in this country to-day. Mr. Smith is a hard-headed Scotchman and his enthusiastic appreciation of the value of these cattle left no doubt in my mind, had there ever existed one, that we have here a foundation stock which we must use with the greatest care for the future benefit of Mysore agriculture. In connection with any scheme for breeding which I may submit to Government I shall keep in mind the absolute necessity of building so as to improve upon what we have. We have other excellent breeds in the State which in some ways are of as great value as our Amrut Mahal cattle. Unfortunately the necessity for the gathering together of a foundation stock of these cattle will prevent much rapid progress but that should not deter us

from including breeding work on them in any scheme for cattle improvement. Finally in connection with such a scheme we have the human element and it will undoubtedly demand the best we can procure in the way of trained men to carry out an adequate scheme for cattle improvement. In this connection I should like to point out that we have in some of our older and more experienced *Servegars* and in the breeders of Nagamangala, Kankanhalli and other taluks men with a practical knowledge and a feeling for cattle whose services must be enlisted in the work. It is a thousand pities that not more of these men are educated as I can think of no better class from which to draw our future Live-Stock Officers. Is it too much to hope that among the sons of our cattle-breeders we shall be able to find men to help us in this work ?

Any scheme for cattle improvement must, I think, include the establishment of at least one breeding station where work can be carried on under scientific control. The station should be established on land in the possession of the Amrut Mahal Department and in an area where our best Amrut Mahal herds are at present to be found. The *Kavals* in the neighbourhood of Birur and Ajjampur seem to meet these requirements admirably.

The chief function of a Government breeding station must be to supply high class bulls to be used in grading up the village stock. The numbers that can be produced from such a station will be so small that a promiscuous distribution throughout the State seems out of the question if we are to make a real impression on the problem of cattle improvement.

These bulls will have to be placed largely in the hands of individuals or co-operative societies in suitable areas who will in turn be in a position to distribute their progeny to the surrounding villages. We should, I think, be able to include with great profit the older and more capable *Servegars* in such a scheme granting them, if necessary, blocks of Amrut Mahal *Kaval* lands on favourable terms on the condition that they agree to work under departmental supervision.

I may say that there can be no thought of developing such a scheme overnight. The change from the system or lack of system at present prevailing in the Amrut Mahal Department to an organized and scientific breeding establishment will have to be made gradually and may take as much as five years. Even then it may be advisable

to retain a certain number of animals in their present semi-wild condition so as to ascertain whether domestication has really any effect on the character of the breed in the way of favouring animals which under the more rigorous semi-wild conditions would not survive.

I find, gentlemen, that I have already occupied too much of your time and I therefore cannot refer to the important question of the improvement of our well irrigation and the interesting, if less important, one of the possibilities of bee-keeping as a subsidiary agricultural industry. I would recommend them to your serious consideration and am sure that the discussions of the next two days will bring out much of value in connection with them.

Finally, Sir, I wish to express on behalf of the members of the Mysore Agricultural and Experimental Union our deep appreciation of the honour you have done us in consenting to preside over our meeting to-day. I should also like to thank the many present who are not members of the Union for the interest they have displayed by accepting our invitation. It is an indication of your appreciation of the fact that the prosperity of this fair State depends on no other factor so much as on the development of Mysore agriculture.

Eleventh Annual Report of the Mysore Agricultural and Experimental Union, 1928.

BY

The Secretary.

It gives me much pleasure to welcome you to the Eleventh Annual Meeting of the Mysore Agricultural and Experimental Union and to submit the report for the year 1928.

The Mysore Agricultural and Experimental Union was started in 1918 with the object of bringing together the men trained in our Agricultural School, agriculturists of experience and the staff of the Agricultural Department.

The most important item of its activities has been the trial by the members in various parts of the State of improvements recommended by the Agricultural Department. The Union commenced its work in a very humble way with 12 members on its rolls. The statement appended shows how it has grown in strength during the

past ten years. The present strength of the Union is 235 members of whom 81 are officials of the Agricultural or other Government Departments and 154 are non-officials.

The Routine of Work.—As regards experimental work the Managing Committee draws up a programme early every year. The programme is printed and sent round to members to ascertain what work they are willing to undertake during the year. Materials intended for experiments are supplied by the Agricultural Department generally free of cost to members undertaking work. The Union sends printed forms of instructions in detail as to how the trials are to be made. If desired, the Agricultural Department also assists the members in laying out plots for experiments. The Union supplies printed forms on which report of the results of experiments are to be made. These results are discussed at the annual meeting. At this meeting subjects of general agricultural interest are also discussed. During the meeting, members get acquainted with the work being done at the laboratories of the Department and at the Central Experimental Station at Hebbal. The Union also publishes a quarterly Journal in English. The quarterly Kannada Journal which was being published and which was stopped towards the latter part of 1923 has just been revived. The Journals keep a record of work done and provide agricultural knowledge of practical usefulness to the members and subscribers. The programme of experimental work for 1929 printed elsewhere, shows the nature of work being done.

Work during the Current Year.—Very little or none at all of experimental work was done during the past two years or so. The Union was, as it were, resting during this period and from that unfortunate rest, it is just awakening. As stated in the previous report, no experiments were conducted during 1927. During the present year 15 members undertook work. The details are appended. The crops not having been harvested, the results are not available for discussion at this meeting. Nine manurial experiments with sugarcane and paddy are being conducted. These are the more costly of our experiments. It is very gratifying to record that Messrs. Brunner Mond & Co., the famous manure dealers who are doing a great deal of propaganda in the State, placed at the disposal of the Union free of cost nearly a ton of manure for trial. The thanks of the Union are due to Messrs. Brunner Mond & Co.

As regards the experimental work of the Union, it has been stated more than once that the larger number of our members are of the "absentee" kind. The position is so disheartening that a member has brought up a resolution making it binding on every member to undertake some kind of experimental work or other. In fact, there is a feeling that the Union is being swamped by members who have only a subsidiary interest in agriculture. But the great point about the work is its voluntary nature. It is hoped that the warning conveyed in the proposed resolution will serve as a necessary corrective and that the "compulsory scheme" will not be pressed.

The Hassan Branch.—Members of this Union in the Hassan District have formed themselves into a branch Union for purposes of local propaganda and extension of experimental work. Some of its members have undertaken experimental work this year.

Affiliated Associations.—Consideration of the subject of affiliated associations which was brought up for discussion was postponed for consideration at this meeting. The subject will have to be considered at the business meeting to-morrow.

The Journals.—As stated in the previous report, the Journal of the Union has been very badly in arrears. Since the last meeting in May 1928 (the 1927 Annual Meeting was held in May this year) the following numbers have been issued :—

Vol. VIII, Nos. 3 and 4 on 10-8-1928.

Vol. IX, No. 1 on 19-11-1928.

Every effort is being made to bring the Journal up-to-date.

The Kannada Journal.—It was decided at the last meeting that Government should be requested to grant an enhanced subvention to enable the Union to revive its Kannada Journal and that on Government sanctioning it, the Kannada Journal should be published as a monthly. Government graciously sanctioned the enhanced subvention recently. The first number of the Kannada Journal has just been issued. But for the co-operation of our printers, the Bangalore Press, it would have been impossible to issue the first number in so short a time as a fortnight. Our thanks are due to the Bangalore Press.

In connection with the Kannada Journal it seems necessary to say a few words. The quarterly Kannada Journal before it was stopped in 1923 had a circulation of 400. The District and Taluk Boards were subscribing for the largest number of copies while a few

of our non-English-knowing agriculturists were on our lists also. The suffocating atmosphere of the "Retrenchment Days" practically smothered this infant Journal. The District and Taluk Boards stopped subscription. The Government cut down the subvention by half. Under these circumstances, the Union with its humble income could not afford to continue the Kannada Journal. The result was that a good number of members were practically forced to leave the Union. The number of members fell from 301 to 227. We lost also the sympathy of more than 150 individual subscribers. Thus the Union's work received a serious set-back and it has not been able since to recover lost ground due also to the forced rest it has had to suffer from in more recent years. To some extent at least, the old enthusiasm on the part of our members seems to have returned as evidenced at the last annual meeting. But with reference to the Kannada Journal it seems necessary to be forewarned. It is impossible for the Kannada Journal to pay for itself in a year or two. There are very few vernacular journals in the State, if any, which are thriving well. Firstly, there is the absence of the very essential combination of sympathy and sacrifice. The public want a journal but will not pay for it. And then, the difficulties in the way of a non-political journal like ours are greater in that its scope is restricted to agriculture. All these point to the necessity of making sure, so far as we can, of our future before we can venture far. In the first place, State aid should be assured for a period of at least five years in the first instance. Secondly, members should make it binding on themselves, in the interest of the Union, to popularise the journal in their localities and to see that every literate agriculturist subscribes for a copy.

A standing complaint with reference to the quarterly Kannada Journal used to be the alleged paucity of contributors of articles on agricultural subjects apart from the officers of the Department and the still greater paucity among the English educated, who can translate the English into Kannada. There seems to be no foundation for either of these allegations. The vernacular newspapers often publish articles on agricultural matters contributed by agriculturists in chaste Kannada, although there is, generally, evidence of lack of information in those articles. The inability to translate or to write

in Kannada direct on the part of the English educated seems more of a convenient excuse than a fact. It often results from diffidence for which there is no justification. The position of an editor who has to spin literary stuff to fill up space from page one to page last is unenviable. It is hoped that members will not hesitate to share their knowledge and experience with others engaged in the same profession as their own. In fact, as stated in a previous report, there are many among our non-official members who have both experience and ability to express themselves in writing, who are now taking just but a passing interest in the affairs of the Union.

A subject which has been mentioned more than once in this report is the Scheme of Colonization to settle down men trained in agriculture on the land. It is a matter of gratification to the Union to find that the scheme has been under the most sympathetic consideration of Government and that preliminary work has been started under the supervision of Mr. D. G. Ramachandra Rao, who has himself had a great share in drafting the scheme. While it is too much to expect the scheme to have progressed very far in a few months, the hope may be expressed that the Union will have at least an advisory voice in the working of the scheme and that the scheme itself will be worked with the strictest regard to economy both in the initial and subsequent stages.

The statement of income and expenditure is appended. It only needs to be added that the annual fee and Journal subscription for 1928 is yet largely in arrears and as the first number of the Journal is just issued, the dues will have to be collected by sending the Journal by V. P. P. The subvention recently sanctioned by the Government has not been drawn yet.

Balance Sheet as on 31st October 1928.

Receipts.	Amount.	Expenditure.	Amount.
	Rs. A. P.		Rs. A. P.
Opening Balance	341 4 6	Establishment	821 14 0
Admission Fee	93 0 0	Printing Charges	564 0 0
Annual Fee	80 0 0	Postage	10 8 0
Subscription	54 9 0	Adjourned Annual Meeting Expenses	85 0 0
Subscription for Annual Meeting	25 8 0	Miscellaneous	3 6 9
Advertisement Charges	37 0 0		
Miscellaneous	4 4 0	Total ..	1,484 12 9
Subvention	1,000 0 0	Cash on Hand ..	150 12 9
Total ..	1,635 9 6	Total ..	1,635 9 6

Details of Work undertaken by Members during the Seven-year Period—1922-1928.

Year.	No. of members on the roll.	No. of members undertaking work.	Trial of Implements.	Trial of varieties of seed.					Manurial Experiments.		Treatment against diseases.					Control of Fungus Diseases.	Sunflower Ensilage.	Sericultural Experiments.		Farm Accounts.	Cotton.
				Ragi.	Groundnut.	Castor.	Paddy.	Sugarcane.	Cane manure	Paddy manure.	Sugarcane Borer	Pests of stored Pulses.	Coffee Borer.	Cardamom Caterpillar.	Lime-tree Borer.			Rearing.	Reeling.		
1922 ..	282	41	20	15	20	8	5	12	..	..	..	..	..	..	..	..	..	..	..	..	..
1923 ..	301	37	2	18	19	12	..	14	7	6	5	5	..	..	..	1	14	7	3	..	6
1924 ..	227	26	9	16	12	8	8	4	6	8	1	1	..	..	..	3	10	7	6	5	3
1925 ..	219	38	13	20	18	13	12	9	1	11	2	1	..	..	..	2	10	6	6	8	2
1926 ..	215	20	‡ 5	12	9	7	11	12	‡ 4	‡ 4	‡ 2	‡ 2	..	..	..	1	‡ 7	‡ 3	‡ 2	6	3
1927* ..	201	18	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
1928 ..	235	15	..	6	6	..	..	3	2	12	..	..	..	..	..	..	..	..	..	..	..

* Material not having been supplied, no work was done.

‡ Not conducted.

Work undertaken during 1928.

Serial No.	Name of Member.	Experiments.
1	Mr. Anne Gowda	Sugarcane Manuring.
2	,, Balavanta Rao Uchagoakar	Paddy and Sugarcane, Cane Manuring and Paddy manuring.
3	,, B. Krishnamurti Rao	Ragi.
4	,, S. C. Mallaiah	Ragi, Groundnut (not sown) and Paddy Manuring.
5	,, V. Mukunda Rao	Sugarcane.
6	,, S. Munisamy Gowda	Sugarcane.
7	,, L. Narasinga Rao	Groundnut.
8	,, M. Ranganayakulu Naidu	Ragi and Groundnut.
9	,, A. Ramaswamaiah	Paddy Manuring.
10	,, M. Subba Rao	Paddy Manuring and Maintenance of Farm Accounts.
11	,, K. Srinivasa Rao	Ragi, Groundnut, Paddy Manuring and Maintenance of Farm Accounts.
12	,, T. Srinivasachar	Ragi and Groundnut.
13	,, H. Srinivasa Rao	Ragi, Groundnut and Sugarcane.
14	,, R. Soorappa	Paddy Manuring.
15	,, G. T. Venkatachar	Paddy Manuring.

Presidential Remarks.*

BY

Rajakaryaprasakta Diwan Bahadur M. N. Krishna Rao, Esq., B.A.,
Member of Council, Mysore State.

When I was asked by Dr. Coleman to preside on this occasion, I felt that I could not respond to the call as I had no equipment to occupy the Chair at a meeting of practical agriculturists. I am not an agriculturist myself, nor can I claim to have devoted any great attention to the study of problems bearing upon agriculture. I therefore asked Dr. Coleman to kindly excuse me, but he would not comply with my request. He was insistent that I should respond to his invitation. My high regard for him and his power of persuasion decided that I should be here to-day. Though not an agriculturist, I take much interest in the agricultural advancement of the State, and I am, therefore, grateful to Dr. Coleman for having given me an opportunity to be associated with this annual meeting of the Union.

2. I wish to congratulate the Agricultural Department and this Union on the return of Dr. Coleman to continue to direct their activities. It is superfluous to dwell upon the great value of the work on which both are engaged. Their high mission is very appropriately expressed in the motto of the Union: "Agricultural Development—the Hope of the Nation." The foremost problem which I consider should occupy the best attention of us all is how to improve our agriculture in all its branches. Production of food and clothing, enough for all and within the reach of all, should be the essential condition of any community which can be regarded as having reached a satisfactory stage of development and it is to the Agricultural Department we mainly look for help and guidance in solving this supreme problem. The real prosperity of a country consists, I think, in the efficiency of its agriculture.

3. We have in our Agricultural Department a body of officers who possess high scientific attainments, who are deeply devoted to their work, and who have already to their credit a large amount of original work of great practical value. The Department is presided over by an officer who is deservedly held in high esteem in the whole

*At the Eleventh Annual Meeting of the Union on the 21st November, 1928.

of India for his contributions to the development of agriculture. To his achievements as a scientist and as a very able administrator of his Department, Dr. Coleman adds the rare qualification of being the friend of the ryot whose difficulties he understands and appreciates and whose confidence he enjoys in full measure. We should congratulate ourselves on having an Agricultural Department so well equipped for the investigation of problems of vital importance committed to its care.

4. Agriculture in India is now receiving considerable attention thanks to the great interest evinced in it by His Excellency the Viceroy. The Report of the Royal Commission on Agriculture was published some months back and the Central and Provincial Governments in British India are considering measures for giving effect to the recommendations of the Commission. I understand that Dr. Coleman himself is now engaged in a study of this Report and we may confidently look forward to his giving a further impetus to the progress of agriculture in the State.

5. I wish to offer a few remarks on the Report of the Union read by the Secretary and suggest a few points for consideration. In one of his addresses to the Union, Dr. Coleman sounded a note of warning to laymen, who assume the role of critics or advisers. This is what he stated : "There is still, I fear, a tendency for many of us to look upon agriculture as a subject upon which any and every one is capable of expressing a valuable opinion which he is apparently able to evolve from his inner consciousness without undergoing the painful process of seriously studying the question. Surely, it is time that all of us abandoned such an idea." I quite agree with him and I fully realize my limitations as a layman. The few observations I offer are made with much diffidence.

6. The Report for the year 1928 to which we have just listened, though brief, contains much food for thought. It frankly states that very little of experimental work was done during the past two years and that the Union was having a spell of rest. One is, however, glad to learn that the Union is astir again and that it promises to work with redoubled vigour and give a good account of itself in the future.

7. I am glad to see that the publication of the Kannada Journal has been revived. I should think that the Kannada Journal is not less important than the English Journal. The appeal for financial

support in the form of a large number of subscribers and of aid from Government will, I hope, meet with sufficient response. The Report states that the public want the Journal, but only they do not want to pay for it. It is something to be thankful for that there is, at least, a demand for the Journal though there is no disposition to pay for it.

8. I have been somewhat disappointed at the poor response on the part of the members of the Union to the invitation of the Department and the Union to adopt new methods, processes and appliances, to study their working under different conditions and to record results, for adding to the body of knowledge on each subject and for facilitating further investigation and experiment. I find that while the membership of the Union has varied between 300 to 200, the highest number of members undertaking experiments and investigations was only 41 in 1922 and the number has steadily declined in subsequent years. In seven years the total number of experiments of all kinds carried out by the members of the Union does not appear to have exceeded 600. This is not an encouraging position. The harvest to be gathered truly is plenteous but the labourers are few. If we should make a real advance in our agriculture, I think, we should count the number of experiments not in tens or hundreds, but in thousands.

9. Dr. Coleman has repeatedly emphasized the fact that experiments have largely to be conducted on private lands with a view to testing the improvements suggested by the Department under varying conditions of soil and climate. Results of proved value will benefit the State as a whole and it seems to me therefore that it is worth while offering, if necessary, stronger inducements than now to persons who are competent to conduct experiments and undertake to carry them out, and give the Department and the Union reliable reports of the results of their trials, tests and observations. In one of his addresses to the Union, Dr. Coleman has remarked that the main business of agriculturists is, after all, to make money and not to carry on experiments. The progressive decrease in the number of members of the Union who are undertaking experiments perhaps points to the fact that they are not inclined to take up this work because it brings them no money. While it is necessary that experiments should be carried out, and carried out also in a large number of cases, experience shows that past efforts in this direction have not met with much success. There appears therefore to be a real difficulty in this respect and what

measures might be adopted to overcome it is, I believe, one of the important subjects for consideration at this meeting of the Union.

10. I should like to say a few words on the problem of fodder. This question became very acute in 1923 and I find very interesting discussions on the subject in the Journal of the Union for that year. Dr. Coleman, however, expressed the fear then that the trouble might be forgotten and no attempts made to prevent a recurrence of the conditions which caused so much anxiety and loss in that year. I have not found as much reference to this subject in the Journals of later years as might have been expected. I hope, however, it is not due to the fact that the problem is not receiving as much attention as it deserves. Some definite lines of work for solving this question were suggested and it was also held that our goal should be 'one year's reserve fodder always in stock'. I should be glad to learn that some positive action has been and is being taken to achieve this object. It is now nearly five years since the problem was considered in all its phases and I should be particularly interested to know how far the possibilities of new fodder crops and new fodder trees have been tested. It was stated in the Report of the year to which I am referring that Dr. Kunhi Kannan had introduced a new fodder tree, the " Mesquite " which seemed to be full of promise. I hope this experiment has proved successful and contributed to the solution, to some extent, of the problem of fodder. I attach the highest importance to this question and I hope that the Agricultural Department will adopt all possible measures, if necessary, in collaboration with the Forest Department, for encouraging the growing on a large scale of fodder crops of all kinds, whether indigenous or exotic.

11. Another problem to which I should like to refer is that of manures. The Department has done a great deal for developing agriculture by proving the possibilities of improving the yield of several kinds of crops by using different kinds of manures and also by popularising the use of commercial fertilizers. The point, however, to which I would invite particular attention is that relating to green manures. Commercial manures will not be within the reach of all. They are also, for the present at any rate, articles to be obtained mostly from outside and it will take a long time before they are produced here in large quantities. I do not know if an investigation into the manurial value of leaves of different plants and trees has been

made. The use of *'Soppinabettas'* for manurial purposes is, I believe, a common practice in the Malnad, but the manurial properties of the different kinds of leaves have not apparently been tested. I would suggest a systematic study of manurial crops and green manures on which, to a large extent, the poor ryot has to depend.

12. A large number of Village Panchayats have recently been organized and I understand that many of them are working fairly well. I do not know if the question of pressing these local bodies into service for having small demonstration plots in villages for popularizing the use of improved seeds and implements, and of new methods and processes has been considered, and whether any work in this direction is likely to prove useful. I would suggest this as another subject for consideration.

13. I am glad that the Department has been able to get an addition to its budget this year and that its staff, particularly that employed in the districts, has been strengthened. Dr. Coleman's desire to have one Agricultural Inspector and two Fieldmen for each taluk has not yet been realized. It seems to me that the amount we spend on the investigation of agricultural problems and on the propagandist and educational work of the Department is quite inadequate, considering the vital interests involved, and the immense amount of work yet to be done. The Government here is the landlord and the improvement of the productivity of land should be of supreme importance to it. Including the different cesses, the annual revenue which the Government realizes from land is nearly a crore and a half, while the amount spent on the Agricultural and Veterinary Departments is only about Rs. 7 lakhs. I think there is a clear need for a substantial increase of funds for expanding the usefulness of these Departments.

14. The present scale of operations of the Department relating to the supply of seeds and manures to cultivators is unduly limited. I find from a reference to the figures of the past few years that the annual transactions amount to about a third of a lakh. I think that vigorous attempts are necessary for extending the range of these operations.

15. Much research work is being carried on by the Department, but, I believe, the scope for it is unlimited, while the need for expanding it is very great. May I throw out a suggestion and make an

appeal ? Research work of every kind requires encouragement and I venture to think that agricultural research has the foremost claim on persons who desire to contribute to the general good of the community. Every year the University is turning out a number of Science Graduates and there must be a few among them who possess the equipment and the aptitude required for conducting research work. I would suggest for the consideration of persons who wish to make endowments that their investments might take the form of studentships for agricultural research. They are the real benefactors of mankind who contribute towards the production of more food and more clothing and to a fairer distribution of these necessaries of life. These studentships may be for short periods, say for five years and those who make the endowments might specify the subjects in which investigations should be carried out. The sums to be invested for providing for annuities payable during short periods will not be large. It is worth consideration whether some of these studentships might not be founded by the Government also.

16. With these observations and suggestions, Ladies and Gentlemen, I have much pleasure in opening the Eleventh Annual Meeting of the Mysore Agricultural and Experimental Union, and wish it every success.

Cattle Breeding and Disease Control.—I. *

BY

N. Krishna Iyengar, B.A.,

Inamdar, Uragahally Estate.

Considering the geographical situation of the State, its being a high tableland with well-distributed seasonal rainfalls, numerous large perennial rivers and lofty hills and mountain ranges well studded with forest vegetation and vast plains covered with rich pasturage for cattle, we have to come to the conclusion that it is an ideal place, intended by Providence and fitted by Nature as the habitation of cattle and an excellent agricultural country where all kinds of vegetables, fruits and grains fit for human consumption could be grown with ease and certainty.

Being thus bountifully provided, it is no wonder that cattle-breeding has, from time immemorial, been established as the prime

*Speech at the Eleventh Annual Meeting on the 21st November, 1928.

concern of the human beings inhabiting it, as it is cattle that facilitate for man his agricultural operations which give him food and occupation. The eminent Hindu kings of ancient India took great interest in cattle breeding. So also did the rich mercantile classes not to speak of the humble agriculturists. The Hindu religion also attached great sanctity to the cow and the bull and so they became even venerated as embodiments of the Divine Being. This gave a great impetus to cattle breeding and *Gosalas* were maintained in every town and village.

This was the state of things so long as the Hindu sovereigns reigned supreme in the country above the Vindhyas. But as soon as the foreigners stepped in, and the country was devastated by war and pestilence and there was no guarantee of human life and property, agriculture and breeding of cattle were neglected as an inevitable consequence. People abandoned their houses and fled for the safety of their lives taking with them whatever property it was possible to take. So it happened that people from the north attracted by the natural facilities mentioned above sought refuge in large numbers with their cattle in the Mysore country and thus was introduced into Mysore a new breed of cattle—the *Hallikar Breed*, being so called by the caste of the owners, a sub-sect of *Gollars*. This in course of time by interbreeding with the local cattle became known as the *Mysore Breed*. As these *Hallikars* were experts in cattle breeding and also combating cattle diseases, excellent strains of cattle were selected and their breed multiplied in the vast grazing lands that were then available. The country thus actually flowed with milk and honey. A man's wealth in those days was judged by the number of cattle he owned. The sovereigns of Mysore observed that the Mysore cattle were very efficient for military purposes and freely used them in their wars. They even organized a department to improve the breed and named it the *Benne Chavadi*. This department was still further developed and improved during the reigns of Hyder Ali and Tippu Sultan and the department was named Amrut Mahal. During the Mysore Wars the commanders of British armies discovered that Tippu was able to transport his heavy guns and baggage with great ease and rapidity over long distances of country where there were no roads chiefly on account of the good bullocks used for drawing the gun and transport carriages. After Tippu's fall

the British officers took care to maintain and even improve Tippu's cattle department then known as the Amrut Mahal. In consequence of this the Mysore cattle attained a world-wide reputation as being very efficient for military purposes. But after a time when peace had been established all over India the British officers considered that the maintenance of this department at a heavy cost was not necessary as such cattle could be had from private individuals for reasonable prices and therefore ordered the closing of that department and the sale of its herds. But very soon it was realized that a serious mistake had been committed by adopting that course, as the price of the very few good cattle that were available went up abnormally and so the department was ordered to be re-established. But it was discovered that very few cows and bulls of the real old Amrut Mahal breed were available owing to the Padshah of Egypt having purchased a very large number of them when the department had been closed. Fortunately, however, Maharaja Sri Krishnaraja Wadiyar had, like the Padshah, purchased a good number of them and so the Madras Government was able to obtain from him a good number of cattle and re-organize the Amrut Mahal Department. But all the same it was found that cattle of the original pure stock could not be had. A large number of cattle that had the blood of the Mahadeshwara breed were also among the number. The *Servegars* who had been entrusted with the work of collecting and breeding the stock were not very scrupulous in their dealings and availed themselves of the opportunity to supply to the department cattle of inferior breed. The present Amrut Mahal breed cannot therefore be considered to be as pure as it was originally.

The herds owned by the *Gollars, Hallikars* and other cattle breeders, had also suffered in purity. These breeders had to produce a strain which satisfied the market. The people of the country surrounding the Mysore table-land are the chief purchasers of Mysore cattle. They wanted a high standing, compact heavy animal and so the *hallikar* and Mahadeshwara breed were inter-crossed with the result that it is very difficult to find pure *hallikars* now. The expansion of cultivation, scarcity of rainfall and the ravages of contagious diseases have all contributed towards the deterioration of the Mysore cattle.

The Mysore breeder knows full well the value of the sire in his operations. To this end formerly the villagers used to select a good

bull and allow it to roam about with the village cattle. Although the practice of castrating undesirable males was not in vogue, the village bull being well fed and powerful could easily keep them away from serving the cows. This system has given place to a still better one, that of keeping good bulls for service for a fixed fee. Though many have specialised in the work they find it very difficult to secure good bulls as their parentage is unknown. While selecting bulls for breeding purposes they have thus to be content with good external points and leave to chance their capabilities to breed true. Another factor has been operating detrimentally against the securing of good bulls for breeding. The market for Mysore cattle has come to realize the advantage of purchasing young stock and training them for the work expected of them. In addition to this other countries have been purchasing good bull calves for breeding and offer tempting prices resulting in the depletion of such stock for selection by local breeders. Expansion of cultivation has in its wake reduced the number of cattle and contagious diseases have also contributed to their depletion, cattle fairs and *jatras* helping their spread. All these causes combined leave the local breeders in a helpless condition and so they are obliged to be content with inferior bulls for breeding.

The Amrut Mahal cattle being kept in a semi-wild condition, away from villages, are in a better state of purity at present than *hallikar* cattle kept by private owners. Naturally one interested in cattle improvement has to turn in that direction for the selection of bulls. Here again the parentage being unknown breeding is reduced to one of chance. The conditions under which they are reared very often preclude them from being serviceable, many a bull declining to serve under restrained conditions. This, in my opinion, is one of the chief reasons for the ryots not availing themselves of the concessions given by Government for the supply of Amrut Mahal bulls, not to mention the difficulty of transporting and domesticating them. Under these circumstances I should like to suggest the formation of a herd of select Amrut Mahal cows and bulls of a standard type from the different Amrut Mahal herds, this herd being kept under domestic conditions, regular and faithful records of their performance being maintained. If necessary a few selected bull calves owned by private breeders may also be introduced. With proper scientific control I am confident that a pure strain of Mysore cattle could thus b evolved

in the course of a few generations when Government would be in a position to help the Mysore breeders in their operations by providing them with good male and female stock.

The other equally important lines of improvement for the betterment of Mysore cattle, such as housing, the improvement of fodder supplies and the control of epidemic diseases, I shall leave to members who are better fitted to deal with them.

Cattle Breeding and Disease Control.—II. *

BY

M. S. Lingegowda,

Jodidar, Vasantapur Estate.

Mysore is well known for the breeding of famous draught bullocks—the Amrut Mahal, the Hallikar, the Mahadeswar Bettada Dana, etc.

The number of cattle according to the latest census of 1925 is :—

Bulls and Bullocks	..	..	15,40,977
Cows	..	..	14,95,741
Young Stock	..	..	9,95,447

It is a mistake to suppose that all these are useful cattle or that they belong to any of the pure breeds mentioned. The largest part of these form a class by themselves, the scrub cattle, with which the agricultural operations of the country must be carried out. The ryot attempts by maintaining a huge number of useless animals to make up for the poor quality of his cattle. In order to produce this huge number of bullocks he maintains an almost equal number of cows. The cow and the young stock are among the most neglected of his live-stock. They are expected to shift for themselves. During a period of fodder or water scarcity and prevalence of contagious diseases like Rinderpest, the cows and young stock die in huge numbers. The latest cattle census reveals a shortage of 1,56,025 bulls and bullocks, 2,21,415 cows, and 8,85,283 young stock, over the stock during the previous census in 1921. When to this number is added the number representing the normal increase in five years, the terrible loss of cattle during the fodder and water scarcity of the three years 1923-25 can be realized.

* Note read at the Eleventh Annual Meeting on 21st November, 1928.

The bullock is, and will always continue to be, the chief source of motive power on the farm. Agriculture cannot improve very far as long as these inferior cattle are to be depended on. The use of improved implements is impossible with these scrub cattle. Mysore seems to be fast losing its reputation as a country of famous cattle. The solution consists in improving the quality of cattle by systematic breeding and large-scale distribution of pure-bred bulls as recommended by Mr. N. Krishniengar. In order to accomplish this a large Cattle Breeding Station is quite necessary. The present Amrut Mahal Department should be converted into a Cattle Breeding Department capable of supplying at least 500 young bulls every year.

After this is done, there ought to be wholesale castration of useless bulls in order to make it impossible for scrub cattle to be born.

Every effort should be made to protect cattle from epidemic diseases which are killing our live-stock by the lakhs in bad years.

The improvement of fodder supply should be considered along with the subject of cattle improvement. Ultimately when useless cattle cease to exist, the problem of fodder supply will solve itself. If it is worth the while to keep an animal, the ryot will feed it and care for it properly. But in the meanwhile all sources of fodder supply such as forest grass, growing fodder crops and stocking in silo pits for use in summer, etc., should be fully exploited.

Cattle Breeding and Disease Control—III.

BY

Major R. W. Simpson, M.C., G.B.V.C.,

Superintendent, Civil Veterinary Department.

Cattle breeding, I may safely say, is the most important industry in the State, as it brings in without exaggeration, half a crore of rupees every year. Practically every ryot, even the poorest, owns a cow of sorts, and the money he gets on its calves pays for clothing for himself and his family. The importance of this industry was realized long years ago by the Hindus of ancient times when they organized that very important institution "The Village Buswah" or breeding bull, and in order that it should be venerated, cared for and not harmed in any way, it was given a religious significance but with the advance of time the greed for money and the factious spirit in villages have overcome these religious observances, with the result that the village Buswah has become almost a thing of the past. The cattle owners of to-day look to their present gain and sell all their promising young bulls which are taken out of the State. At present it can be safely said that there are not more than 200 good breeding bulls in the Mysore State. It is at least five years since I have come across a really good shapely breeding bull and it is quite time that measures were taken to ensure that every village has at least one good breeding bull available for service for the cow of even the poorest ryot.

If cattle could be kept up to a high standard, there would not be so many scrub and useless cattle in the State as there are at present. These useless cattle bring in practically no return to their owners while they are devouring food at the expense of the more valuable cattle. It costs nearly as much to keep a good animal as a useless one, so would it not be a much sounder policy for Government to encourage stock owners to breed up to a certain standard so that the surplus cattle will find a ready market and thus bring money to the people ?

Government have from time to time made certain concessions to enable people to secure and maintain breeding bulls, but from experience it is found that these concessions serve no useful purpose. People who have secured young bulls at concession rates have sold them on getting a tempting offer. Subventions have been given, but

these have been very few and have only helped to benefit a few and have not in the least helped to serve the poor man's cow.

The old institution of the Village Buswah must be introduced again without further delay, and to prevent them being sold, they must be the property of Government as far as possible, and loaned to the different villages with the specific understanding that they are to be maintained as Village Buswahs so that every ryot may have the service of the bull for his cow. A question has been often asked "Who is to maintain them?" The villagers of course and many villages have consented to do this. During eight months in the year there will be plenty of fodder about, and during the dry months the villagers will contribute one large bundle of straw and a seer of gram for each cow they possess towards the maintenance of the bull.

I propose that Government should be asked to provide a lakh of rupees a year for the purpose beginning with this current year. Of this amount Rs. 50,000 should be used to purchase promising young bulls for distribution, and the other half for domesticating Amrut Mahal bull calves. I also propose that steps be immediately taken to round up all the young Amrut Mahal bulls of 2 years and over that are not required for the herds and move them to the Birur Kaval where they should be enclosed separately in Kraals or cages, six feet square and hand fed. As soon as they get used to this restraint, they should be moved and left with their nose ropes for a fortnight and when they get used to the nose rope, they may be pulled about with a string attached to the nose rope. In this way they can be easily handled in two or three months' time without losing condition. If it is possible to train horses and elephants in this way why should it not be possible to train these young bulls? I am prepared to undertake this and prove that it is possible. The initial expenditure for erecting 50 such Kraals (which will have to be built of teakwood) will have to be provided as well, as also an establishment of at least one Jamedar and ten men to look after the animals, feed and water them.

The Director of Agriculture has an elaborate scheme for providing such bulls in future years, but something must be done this year, and during the next two years, till the scheme is working.

Along with the improvement of breed of cattle, the control of disease must be considered, for so long as disease is allowed to carry away valuable animals, there is no use in attempting to improve the

breed. For the past three years rinderpest has been very bad indeed in the State and a large number of breeding bulls have died. Rinderpest is a preventable disease and could be easily stamped out with the co-operation of the people. The ways in which the people can help are, to prevent the movement of cattle from infected villages, to report outbreaks of disease early and to willingly submit their cattle for inoculation. The people who show the most indifference to inoculation and give most trouble and so are responsible for the spread of disease, are those living in business centres who are too engrossed in business to worry about the few indifferent cows they possess. At the present moment the Department is experiencing difficulty in trying to persuade the people of Gudibanda and Narasimharajapura to produce their cattle for inoculation. These two places situated, as they are, on the main roads, are sources of danger to all cattle passing through. This would not be tolerated in any other country than India, and it is up to you, gentlemen, to see that necessary legislation is passed to prevent it.

The other diseases that cause heavy mortality are Anthrax, Blackquarter and Hæmorrhagic Septicœmia. Fortunately there are means to protect cattle against these diseases, but if the Veterinary Department are to successfully undertake preventive inoculation against these diseases it must be better staffed. Unfortunately in districts where both Anthrax and Blackquarter are always prevalent the representatives of the people on the local bodies were so indifferent that they did not formally trouble to look to the welfare of their people in this connection. They have within the last year or two wakened up to the fact that something must be done to give veterinary aid to the people. I must say that the thanks of the people in the Bangalore and Hassan Districts are due to the Presidents of their District Boards and to a few of their leading representatives, as for example, Mr. Srinivasiengar of Anekal, who are not resting till they secure a Veterinary Dispensary for each Taluk in their district, which is likely to be accomplished next year.

NOTES AND COMMENTS.

Some New Artificial Manures.

During the last few years, *raiyats* have become fairly familiar with manures like sulphate of ammonia and superphosphate. In addition to their being used on a fairly large scale for commercial crops like sugarcane, people are beginning to appreciate their benefits for crops like paddy also. In only a few instances have they been tried on dry crops like ragi.

Besides the above two manures supplying nitrogen and phosphoric acid respectively, there have recently been put upon the market certain combined manures containing both the above plant foods.

One of the first of its kind to come under the notice of the Department is Ammophos manufactured by the Cyanamide Co. of America and sold by Indo-Agri., Ltd. Almost a ton of it was sent for trial from America and it gave very good results with sugarcane and paddy. There are two grades of ammophos on the market, one is called 20-20 grade and contains about 16.5 per cent nitrogen and 20 per cent phosphoric acid and the other is called 13-48 grade containing about 10.5 per cent nitrogen and 48 per cent phosphoric acid. Both the plant foods contained in the manure are in a form easily available to plants. The 20-20 grade is eminently suited for paddy in localities where green manure is not available, whereas the 13-48 grade may be used in conjunction with green manures. About 100 lbs. an acre are quite sufficient for the purpose. For a crop like sugarcane, the 13-48 grade is eminently suited. About 150 lbs. of it per acre may be applied in the furrows just before cane is planted. In addition, about 200 lbs. of sulphate of ammonia may be applied about 8 or 10 weeks after planting cane.

Two manures almost similar to the above are put upon the market by Messrs. Brunner Mond & Co. (now Imperial Chemical Industries Ltd.) and they are leunaphos and diammonphos. Leunaphos contains 20 per cent nitrogen and 20 per cent phosphoric acid. It is slightly richer than the 20-20 grade ammophos in its nitrogen content, and may be employed in quite a similar way.

One grade of diammonphos contains 20 per cent nitrogen and 53 per cent phosphoric acid and is consequently richer than ammophos 13-48 grade. It can be also similarly employed using slightly smaller quantities than the 13–48 grade ammophos.

In both these manures, the nitrogen and phosphoric acid ratio is not what is wanted for our soil conditions. A most favourable ratio of nitrogen to phosphoric acid for our conditions seems to be as 2 : 3. To bring about this ratio ammophos 20–20 grade and leunaphos have to be reinforced with superphosphate and 13–48 grade ammophos and diammonphos need to be reinforced with sulphate of ammonia.

So far as results of preliminary experiments indicate, all these manures seem to have a great future before them in this country. The cost of the plant foods contained in them is cheaper than what it would be if a mixture of sulphate of ammonia and superphosphate has to be used. Moreover, being more concentrated than such a mixture, there is an incidental saving of freight as well.

In some large-scale trials recently conducted with leunaphos and diammonphos on paddy, the manures were applied at the rate of 100 lbs. per acre just before transplanting seedlings of paddy. Leunaphos was tried on 2 acres of land, and the yield was only 2,220 lbs. of paddy per acre. Diammonphos was applied to an area of about 2.4 acres, and the yield was about 2,700 lbs. of paddy per acre. A mixture of oil-cake and superphosphate corresponding to 100 lbs. of either of the above manures in its nitrogen content produced an yield of 2,300 lbs. of paddy per acre when tried on an area of nearly 3 acres of land in the same locality.

One more manure put upon the market by Messrs. Brunner Mond & Co. is worth mentioning. It is called nitrophoska and contains all the 3 essential plant foods, nitrogen, phosphoric acid and potash. As till now in our local experience we have not yet come across a case in which paddy and sugarcane have responded to potash also in addition to nitrogen and phosphoric acid there does not seem to be much use in it for these crops. But coffee and areca seem to respond well to potash also and so nitrophoska may form one of the ingredients for manure mixtures for coffee and areca. Till some experiments have been conducted it is not possible to say anything definite about it. [B.N.I.]

SELECTIONS.

Insects Cause a Yearly Loss of £400,000,000 in U.S.A.

Losses exceeding $2,000,000,000 annually result from insect damage in the United States, nullifying the labour of 1,000,000 men by destroying from one-tenth to one-fifth of all crops, according to a statement by Mr. C. C. McDonnell, who is in charge of insecticide, fungicide, and caustic poison control in the Food, Drug, and Insecticide Administration of the Department of Agriculture, U. S. A.—*The Agricultural Gazette of New South Wales*, November 1928.

Science and Modern Farming.

In 1898 Sir William Crookes predicted that the world in 1931 would require 90,000,000 tons of wheat to feed its population, and that this represented the utmost the world could produce. After that the world would be faced with starvation. The advance of science in agriculture has upset that calculation. Sir William Crookes' limit was exceeded in 1911, and could be enormously increased to-day. The fear of world starvation has fled before the advance of science. The problem before the world now is to ensure that the farmer shall get his fair share of the profit so as to encourage him to use all the knowledge that science can teach.—Sir John Russell, Rothamsted Experimental Station.—*The Agricultural Gazette of New South Wales*, November 1928.

The Tillering of Rice. (*Oryza sativa.*)

1. Influence of Rate of Irrigation and Light in Tillering.

Shinkriki rice received various quantities of irrigation water and several degrees of natural illumination in studies at Kyushu University. The maximum number of tillers were put forth in a soil saturated or only slightly submerged. Insufficient or excessive water reduced tillering. The number of tillers and rapidity of tillering were depressed by reducing the light. The crop per plant estimated on the basis of dry weight of grain, number of kernels, and grain : straw ratio increased with increase in tillering, although the number of spikeless culms also increased. Too thick planting seemed prejudicial to tillering.—*Experiment Station Record*, Vol. 59, No. 2.

Some Experiments on Water-Divining.

The following affords a brief account of some experiments on water-divining carried out near Fyvie Castle, Aberdeenshire, on April 28, 1928, and indicates some inferences which may be drawn therefrom. The dowser was Mr. G. L. Cruickshank, of the Fyvie Castle Estates.

Tests were first made in places where running water was known to be. The dowser made use of a short forked twig, and when he stood over the water-course the twig was forced up. If a piece of thick glass were placed under his feet the sensation ceased and the twig dropped. The same effect was got when the twig was held by two pairs of steel pliers or if the ends held by the hands were first covered with rubber tubing. Likewise, no sensation was perceived if only one end was held by pliers or covered with rubber tubing, the other being held in the usual way by the bare hand.

Another set of observations was carried out with the dowser blindfolded. He was made to cross a line which he had previously made out as being a water-course. Nobody approached within several yards of him. When he passed over the line previously indicated the exact position of which he had no idea, the twig moved upwards. As he passed beyond the line the twig immediately fell.

In those experiments the external manifestation is a forcing upwards of the twig. This raising of the twig must be due to some muscular action on the part of the dowser. This would indicate that he is the mover, though in his own mind he is apt to consider that he is working against some external force. If then his muscles force up the twig, the nerve centres controlling these muscles must have been influenced in some way by an outside stimulus. May it be, therefore, that some kind of influence is radiated from water running under pressure and that a "receiving set" tuned to respond to such a stimulus is possessed by certain individuals? A definite arrangement of the body seems to be necessary for proper reception of such a stimulus and certain substances appear to be able to prevent the arrival of the stimulus. As different individuals may respond in different ways to such stimuli, care must be exercised in drawing general conclusions from observations made on any particular individual.

It seems reasonable to conclude however (1) that the faculty of water-divining is possessed by some individuals; (2) that the individual responds to some, at present unknown, external stimuli; and (3) that certain substances can prevent the arrival of those stimuli, in which case the individual cannot respond.—A. E. M. Geddes, in *Nature*, Vol. 122, No. 3071.

Edible Rice Cellulose.

It is essential that human diet has bulk as well as food value. A diet consisting entirely of proteins and starches leads to constipation, but when a bulk or roughage of cellulose is present, digestion proceeds on its normal course. A breakfast food manufactured from milled rice had a very low cellulose content, and thus was not an ideal food. The deficiency has been overcome by the introduction of a pure edible cellulose made from the hull of the rice. It is prepared by cooking the hull with strong caustic soda solution followed by a hydration treatment to reduce it to a physical form suitable for use as an edible material. In the final state it is a light, fine, mealy material. It is odourless and tasteless and has a mealy feel in the mouth. Analysis of the finally purified product shows it to be practically pure cellulose.

Tests on its dietary value have been carried out on various subjects. In all cases the cellulose added to the milled rice obviated the ill effects of a diet of pure milled rice. It is suggested that the cellulose content of other foods be augmented by the addition of this edible rice cellulose.—*Ind. and Eng. Chem.* 20, 310.

Chemical Control of Plant Growth.

It is often desirable to have plants which will flower or seeds which will germinate before their normal time. Previously this has been brought about as in the case of wheat by process of breeding the new variety, there is always the possibility of losing valuable properties of the parents. It is found that chemical treatment of a seed or tuber will cause it to germinate prematurely, or a bud to flower prematurely. Experiments have been conducted particularly with potatoes. The potato tuber has a dormant period during which it will not sprout. In places where two crops are grown during one year, the length of the dormant period prevents the second crop from being planted with seed from the first. The dormant period is shortened considerably by soaking the cut tubers in one per cent sodium thiocyanate solution for one hour and then planting the pieces without rinsing. A similar effect is obtained by using ethylene chlorhydrin solution or vapour. Treatment with thiourea induces multiple bud development in the potato.

Somewhat similar treatments have been applied to small woody plants such as lilac and Deutzia. By exposing the young plants to ethylene chlorhydrin or ethyl bromide fumes, they were induced to bloom from two weeks to two months prematurely. The more concentrated solutions reduced the number of flowering spikes. The main object at

present is to enable florists to produce flowering plants in time for holiday trade. The idea may, however, have wider application. The seed treatment, especially, could readily be used with other field crops. In cases where early fruiting or rapid establishment of a plant is required to avoid, or to enable the plant to withstand, bad weather or the incidence of a pest, the treatment may prove of great value.—*Ind. and Eng. Chem.* 20, 578.

The Application of Science to Agriculture.

Academically, no one ventures to question the achievements of agricultural science. In the last hundred years the additions to knowledge have been very great, but in the material consequences—the increased production of human food—doubts must arise. Rothamsted itself, by the lips of its director, has been heard modestly to suggest that many of its discoveries have gone to confirm the wisdom of the ages. Even the most progressive country in the world, we are told, feeds itself, in the main, by the exploitation of the fertility locked up in its 'virgin prairies' rather than on the fruits of new knowledge.

Measured in profits, there has been really only one 100 per cent addition to traditional practice in tillage of the soil in the last century, and that is the discovery of chemical fertilizers—that substances extraneous to the soil, of definite composition, can be used to increase its production. Following this epoch-making discovery there have been many others of supreme scientific importance—the new biological activity of the soil may be instanced—but not one of them has had a material outcome comparable with the first mentioned; for they have all been of the same order of magnitude as the seasonal fluctuations by which *pater ipse* has willed that the husbandman's way should be made difficult.

It is, however, only fair to admit that a particular tiller of the soil, fortified at all points with scientific knowledge and endowed with capital sufficient to tide over hard times, such as the present, has it in his power, by adopting all the minor advances which his knowledge suggests, to maintain his average level of profits. Thus he may add one 10 per cent by making use of the improved wheats and barleys with which the scientific plant breeder has presented him; and another 10 per cent by feeding his animals according to scientific principles, and so on. But even the members of the Agricultural Education Association must admit that such men are rare.

The obvious reply is, of course, that the educational standard of husbandmen in general is not high enough. But is not the difficulty

really psychological? The adoption of the teachings of education in the everyday affairs of life is dependent on a will to progress, a desire for efficiency. As the late head of the Educational Department of the Ministry of Agriculture once pointed out (to American students of all people!), the pursuit of efficiency is philosophically not always desirable. A marsh starred with Grass of Parnassus is more productive of peace of mind than its efficient substitute water-cress bed! Rural life is undoubtedly productive of a certain passivity—contentment with things as they are. It is perhaps irreverent to attempt the improvement of Nature's plans. A factory is always crying for improvement, but the lily does not suggest a painter!

Be that as it may, the fact remains that scientific agriculture has not furnished an incitement to the rural worker, unless, possibly, in one direction: the improvement of the animal has always attracted the British farmer, and that as a rule is the chief delight in farming. The animal has proved more plastic than the plant or soil, and it is somewhat unfortunate that the science of animal improvement has scarcely emerged from obscurity. Nevertheless, progress on the practical side is continuous. Such recent triumphs as the 300-egg hen and the 3,000-gallon cow offer the husbandman greater rewards than even the largest gift of the chemist, fertilizers from the air and irradiated foodstuffs.—*Nature*, Vol. 121, No. 3061.

Some Recommendations of the Royal Commission on Indian Agriculture on Cattle Breeding and Control of Cattle Diseases.

Cattle Breeding.

1. The cattle census figures suggest the existence of a vicious circle. The number of cattle within a district depends upon, and is regulated by, the demands for bullocks. The worse the conditions for rearing efficient cattle, the more cattle the cultivator tends to breed in the attempt to secure useful bullocks (Paragraph 168).*

2. The prosperity of Indian agriculture is closely linked with the improvement of livestock (Paragraph 168).

3. Four cardinal points in a policy of improvement must be:

(*a*) attention to all matters that would tend to decrease the number of bullocks required for cultivation;

(*b*) an effort to secure better treatment for dry cows and cows in calf (Paragraphs 170 and 173);

(*c*) a reduction in the number of plough cattle; and

(*d*) an increase in the efficiency of plough cattle.

* The reference is to paragraphs of the Report of the Royal Commission.

4. In nearly every part of India, the common grazing lands and all grass lands close to villages are hopelessly over-stocked (Paragraph 176).

5. No large additions to existing grazing areas are possible and efforts should, therefore, be concentrated on increasing the productivity of the land already growing grass (Paragraph 181).

6. The scope for such efforts is very great. The productivity of the existing grazing grounds could be increased in the following ways :—

(*a*) grazing on the common land could be regulated and rotational grazing established with the consent of the majority of those possessing grazing rights and by means of authority conferred on a group of villagers, for instance on a *panchayat* or co-operative society ;

(*b*) in some instances, a definite area of the common land could be separated off for a village co-operative cattle improvement society ;

(*c*) in hilly districts, where the grazing facilities are better than they are elsewhere, an attempt should be made to demarcate areas to be assigned at nominal rates to groups of occupiers of village lands on the following conditions :—

(*i*) the area shall be grazed in rotation ;

(*ii*) cattle not owned by the group shall be excluded ;

(*iii*) part of the area shall be reserved for cutting grass for use in the hot season (Paragraphs 182 and 183).

7. In all schemes for improving cattle, special consideration should be shown to professional graziers. This should take the form of allotting them new grazing areas from disafforested reserves, or from waste land not classed as free grazing areas (Paragraph 183).

8. The water supply of natural grazing lands should be investigated (Paragraph 183).

9. The importance of cutting and storing dry grass in default of hay, and of making hay wherever conditions admit, should be impressed on the cultivator (Paragraph 184).

10. The possibilities of silage are great. There are, however, practical difficulties in persuading the cultivator to adopt it. The immediate policy should be to concentrate on efforts to get the cultivator to make silage for his cows and young stock, from recognized fodders and inferior grasses which experiments have proved suitable (Paragraph 185).

11. Even when all possible use has been made of existing sources of supply, a shortage of fodder is likely to arise in many parts of India. The cultivation of fodder crops on the cultivators' holding is the only remedy for this (Paragraph 187).

12. If the seed of Egyptian clover (*berseem*) can be produced cheaply and on a commercial scale in India, this crop has great possibilities (Paragraph 187).

13. The cultivation of leguminous fodder crops should be encouraged by the remission of the charge for water from Government sources of irrigation or by the grant of concession rates. The grant of such concessions should be conditional on its being accompanied by active propaganda. All areas in which concession is given should be kept under regular examination (Paragraph 187).

14. The task of the live-stock breeder has been, and still is, to establish pure and improved types of good cattle. This task, in Indian conditions, is often a most difficult one even when a single purpose is in view, and should not be endangered by the quest for dual purpose breeds, that is, for breeds suited for both draught and milking and *ghi* production (Paragraph 188).

15. Very little progress has yet been made by Government cattle farms towards meeting the total requirements for young bulls (Paragraph 189).

16. In India, the costly but essential work of building up herds of pedigree cattle must fall on the tax-payer (Paragraph 189).

17. Caution is required in improving the milking qualities of draught breeds of cattle, lest other qualities which give special value to the breed are sacrificed (Paragraph 190).

18. The grant of land on favourable terms is not recommended as a method of encouraging cattle breeding (Paragraph 190).

19. The policy pursued in the United Provinces of limiting the issue of breeding bulls to selected districts and of regularly inspecting the stock in all districts to which bulls are supplied, is commended for adoption in other provinces (Paragraph 191).

20. No substantial results can be expected from the policy of distributing selected bulls to district boards generally which has been suggested in Madras. Such bulls should be used to raise the quality of stock in selected areas and the improved cattle of those areas should be placed at the disposal of district boards, co-operative societies and other suitable agencies (Paragraph 194).

21. The State of Mysore and some of the States of Central India confer substantial benefits on the cultivators of adjacent administrations by exporting good cattle (Paragraph 194).

22. As a general rule to be followed on the breeding of draught cattle, milking qualities should be encouraged only in so far as these are

entirely consistent with the maintenance of the essential qualities which such cattle must possess (Paragraph 197).

23. The live stock experts of the agricultural departments should not experiment with cross-breeding for the urban milk supply, but can do useful work in improving indigenous dairy breeds (Paragraph 200).

24. Where cultivators evince a real interest in their live-stock, the organization of co-operative breeding societies should be encouraged by the loan or gift of a good bull, and by the provision of grazing ground if available, on favourable terms (Paragraph 202).

25. The export of cows and heifers is usually undesirable and should be closely watched by Government. Unless the extinction of some valuable breed is threatened, the export of breeding bulls should not be prohibited. In the case of certain breeds, export might be subject to license (Paragraph 204).

26. Animals not required for breeding should be castrated as early as possible where public sentiment allows, but care should be taken to ascertain the exact age at which castration can be carried out without interfering with the animal's subsequent development (Paragraph 207).

Control of Cattle Diseases.

1. It is impossible to frame any estimate of the losses to agriculture caused by contagious diseases, but they are undoubtedly immense.

2. Rinderpest is the most formidable disease of cattle in India.

3. In present conditions in India, rinderpest and other contagious diseases must be combated by measures aiming at the protection of the individual animal rather than by measures which aim at stamping out the source of infection.

4. The serum-simultaneous method of inoculation offers the only hopeful method of combating the ravages of rinderpest and its employment on a large scale is, therefore, strongly recommended.

5. With proper safeguards, this method involves a risk so slight that, in view of the benefits conferred, it should be accepted.

6. As the inoculation of all cattle by the serum-simultaneous method is not possible during a widespread outbreak, efforts should be concentrated on protecting the more valuable cattle. The extent to which the serum-alone method should be used concurrently with the serum-simultaneous method must be decided by the veterinary officer in charge of the operations.

7. All inoculation against disease should be done free of charge.

8. Although compulsory inoculation against rinderpest is not recommended generally, it should be enforced for all animals kept by milk-sellers in large cities.

9. The control of measures for treating and preventing the spread of contagious diseases should be regarded as the concern of the provincial Governments ; the duty of providing a local veterinary service for treating diseases not scheduled as contagious and for dealing with operations and wounds should, when the necessary arrangements can be made, rest with local bodies.

The Conservation of Humus in Indian Soils.

By C. M. Hutchinson, B.A., C.I.E.,

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The prime requirement of Indian arable soils is an adequate supply of organic matter or humus ; this statement no doubt partakes of the nature of a truism, but the writer's object in making it is to draw attention not only to certain considerations arising in connection therewith, but to the fact that there appears to have been a dangerous tendency in the past towards failure to recognize its importance.

The functions of humus in cultivated soils are numerous and most of them are well known, although some are still obscure. In India one of the most important is the modification of the relation between soil texture and the supplies of air and water to the plant ; a further one less fully understood has to do with the retention, in an accessible condition, of plant food for the crop. The effect of humus upon soil texture is not only its most important function but is one which cannot be performed by any other substitute ; it is not too much to say that the fertility of a soil depends primarily upon its content of organic matter and that when agriculturists refer to a soil as being "in good heart", they mean that it contains sufficient humus to secure fertility.

To increase the natural fertility of Indian soils we are taught by the experts of the Agricultural Department that it is necessary to practise thorough cultivation, and that the old-fashioned indigenous methods of the Indian cultivator must be improved upon by the use of more efficient implements such as those employed in Western countries. It is indeed easy to demonstrate in actual practice the increase in crop which can be obtained by this method, and as the capital outlay involved is small and the labour required is cheap, the recommendation to make use of increased tillage appears on the face of it a rational one. In 1919 the writer drew attention, in a paper* read before the Indian Science Congress in Bombay, to the danger attending the introduction into India of high-yielding varieties of crops and of intensive cultivation methods ; these were shown

* *Agricultural Journal of India*, Vol XIV, Part 2.

to lead inevitably to depletion of soil reserves in the absence of adequate provision for the maintenance of the latter. In the most recently published number of the *Review of Agricultural Operations in India*, 1925-26, by the Agricultural Adviser to the Government of India, this danger receives official recognition, both with regard to the effects of improved varieties of crops and intensive cultivation. The remedy recommended, however, is the use of organic manures on account of their favourable influence on the texture of the soil, and a warning is given against the employment of artificial manures which have a tendency in the opposite direction. The object of this paper is to draw attention to the fact that although the use of organic manures has all the advantages claimed for it by the Agricultural Adviser to the Government of India, yet it is a mistaken policy merely to advocate the replacement of depleted organic matter of the soil, without making any attempt to find out whether some less exhausting method of securing fertility than excessive cultivation cannot be adopted. This is especially the case where these organic manures are to be considered the principal sources of the necessary nitrogen supply.

It is no doubt necessary in India to make strenuous efforts to improve the primitive methods and implements of cultivation in general use and this, with one specified object amongst others, namely the formation of a deeper layer of fertile soil in a condition of good tilth such as will conduce to the development of a deeper and more extensive root system. Improved cultivation of this type cannot do anything but good, but on the other hand there are mistaken methods of varying it in the direction of multiplication of ploughings which will inevitably lead eventually to disastrous results. Soil humus, far from being an imperishable substance, is rapidly attacked and destroyed by natural processes continually in operation. These processes are in part purely chemical and in part due to the activities of micro-organisms, but both of these classes of action are strongly activated by stirring the soil, which promotes aeration and therewith the numerous oxidizing processes, resulting partly in formation of carbon dioxide and partly of nitrates. The latter are removed from the soil either from the rain-water or by the crop, the former, dissolved in the soil water, helps to bring into solution the mineral constituents necessary for plant growth. Mechanical stirring of the soil produces a further effect in the breaking-down of soil aggregates and particles and thus exposing fresh surfaces to oxidation and bacterial attack; this result is again increased by the mutual attrition of particles which removes from their surfaces the accumulated protective layer or deposit, resembling rust, resulting from the oxidative or micro-biological processes above mentioned.

The obvious effect of this intensive cultivation is an improvement in the immediate yield of the crop due to the increase in availability of the plant food present in the soil; this, however, is obtained not only at the expense of the reserves of plant food in the soil as a whole, but more especially with reference to the destruction of its humus content. This use of the organic matter is a wasteful and unnecessary method of securing supplies of plant-food, whether nitrogenous or phosphatic, for the reason that whereas no other soil constituent can fulfil the special physical functions of humus, it is perfectly easy to supply nitrogen, phosphates and potash, under controlled conditions and in quantities which experiment can determine as suitable in the form of fertilizers. The destruction of serious percentages of the total humus content of the soil in order to secure a few pounds per acre of available nitrogen represents a method as uneconomic and wasteful as that involved in the use of an improperly balanced ration for cattle, in which the presence of an undue proportion of albuminoids involves the utilization of this expensive tissue-forming constituent as a means of heat and energy, in place of securing the latter by the combustion of carbohydrates and fat. In the same way intensive cultivation involves the diversion of an unduly large proportion of the soil humus from its proper physical function to the alternative, or rather additional, rôle of a supplier of plant-food.

It is perhaps well to point out here that humus has an importance in the soil as a possible provider of organic nutrient or possibly stimulant substances to the plant, but on this point our information at present is scanty and uncertain.

It is of course to be remembered that an important function of organic matter in the soil is to provide food and energy for some useful micro-organisms such as the nitrogen-fixers; although cultivation by securing adequate aeration promotes this important action, yet excessive tillage by depleting the soil of its humus will eventually reduce it to insignificant proportions. The loss of humus is accompanied by a corresponding loss of soil nitrogen; this result is drawn attention to by Russel: "Directly ploughing and cultivation operations begin, great losses of nitrogen set in"; and again "The conditions for this decomposition" (involving evolution of gaseous nitrogen) "appear to be copious aeration such as is produced by cultivation and the presence of large quantities of easily decomposable organic matter. Now these are precisely the conditions of intense farming in old countries and of pioneer farming in new lands and the result is that the reserves of soil and manurial nitrogen are everywhere being depleted at an appalling rate."

H. A. Tempany, Superintendent of Agriculture, Leeward Islands, draws attention in his note dealing with fertility of soils in the Tropics, published in the "Transactions of the Third International Congress of Tropical Agriculture" to the rate of decay of organic matter in the soil: "It was found that in periods varying between six and twelve months the contents of organic matter become reduced by amounts ranging between 12 and 30 per cent of the total originally present." This rapid loss of humus occurred both in the laboratory and in the field. Numerous experiments carried out in the writer's laboratory at Pusa showed conclusively, both by measurement of carbon dioxide formation and of loss of nitrogen, that this very high rate of decomposition of organic matter is to be expected at the relatively high temperatures of Indian soils, and that it is greatly accelerated by aeration and mechanical disturbance.

Consideration of the above facts leads to the conclusion that great caution is necessary in making use of intensive cultivation as a means of securing an increase of fertility in Indian soils. We are faced with a problem of great complexity, any successful suggestion of which must depend upon securing much more accurate information than we at present possess as to soil conditions in this country. In the writer's opinion information should be sought along the following lines amongst others:—

(1) Experiments should be carried out to determine the conditions making for excessive rates of destruction of humus in various types of soils.

(2) Experiments should be made to determine the possibility of conserving reserves of humus by reducing the intensity of cultivation and at the same time supplying appropriate quantities of available plant-food in the form of fertilizers.

With regard to (2) it is of interest to note that, when discussing this subject recently with the Chief Scientific Officer of the Indian Tea Association, this gentleman informed the writer that the suggestion above made was in entire accord with the most up-to-date policy of tea cultivation in Assam, as it combined reduction of labour with conservation of humus.

Here may be noted an important principle underlying the proper use of fertilizers in India, namely, that artificials should not be used as substitutes for organic manures but in conjunction with the latter; this does not mean that they cannot be used alone on the land which contains a sufficiency of organic matter, but that the cultivator must not take them as complete substitutes for the cowdung or oil-cake which he would ordinarily employ. On the other hand, it has already been proved that by judicious use of artificials in conjunction with cowdung, the available

supply of the latter can be made to cover a much greater area with economic effect, this being made possible by the use of sulphate of ammonia as a substitute not for the whole usual application of cow manure, but for a third, or perhaps a half, of the latter; in the experimental results which have recently come to the notice of the writer in India, this partial substitution was followed by increases of crop of a substantial order and sufficient to give a highly satisfactory economic return. It is highly advisable, therefore, both in the interest of conservation of humus and of that of the extension of the area under treatment with cowdung or other organic manures, that extensive experiments dealing with the possibilities of this partial substitution method should be carried out. It is perhaps unnecessary to say that such experiments should include investigation of the use of all kinds of artificial fertilizers, as, although the most obvious economic returns have been obtained with nitrogenous artificials, it is highly probable that still better results would follow the use of more complete applications which would include minerals as well.

The value of humus and its functions in the soil are too well known to need further discussion here, but it may be well to draw attention to a particular point in connection with its value as a means of retaining in the surface soil a sufficiency of moisture for the needs of the crop, at a time when arid conditions render such supply necessary. In irrigation tracts there is the danger that the existence of a controlled water supply independent to some extent of climatic conditions, may lead to neglect of the conservation of the soil humus because of the less insistent necessity of observing this as a means of retaining soil moisture; in districts where cold weather crops are grown under arid conditions any such neglect leads to obvious failure; the land is then no longer "in good heart", and can only be brought back into this condition by prolonged operations involving green-manuring, heavy applications of organic manures, or fallowing. As this particular function of humus although of the greatest importance is by no means its only one of value, there is a distinct danger in irrigation tracts of a lowering of soil fertility as a result of failure to keep up supplies of organic matter in the soil, this being a consequence of failure to note the falling off of the crop returns which would inevitably follow any serious reduction of humus content under arid conditions. Thus we may expect to find excessive cultivation practised in an irrigation area as compared with the smaller number of ploughings made use of in other districts. This will in time be followed inevitably by depletion of the organic matter content of the soil and a lowering of fertility, and probably by a corresponding reduction in the effectiveness of irrigation. In this connection it may be well to bring to remembrance Leather's

findings at Pusa which demonstrated the reduction in the quantity of water required to produce unit weight of dry matter in the crop, as a result of provision of suitable supplies of available plant-food in the soil. This affords a further argument for the use of artificials in preference to securing available plant-food by intensive cultivation, because of the comparative ease of providing such plant pabulum at the suitable period of growth by employment of the former. It may be pointed out here that the extensive use of the fallowing practised in the arid regions affords evidence of the recognition of the necessity for the upkeep of the humus content of the soil.

It is impossible to avoid partial destruction of the humus content of cultivated soil, as a result of tillage operations to secure a seed-bed and suitable tilth; it is not however necessary to push this cultivation so far as to destroy large portions of the organic matter of the soil in all ill-advised attempts to make the latter perform the dual functions of providing plant-food as well as soil texture. This partial destruction must be provided against by the use of organic manures, but the quantities of the latter required to secure fertile soil conditions may be greatly reduced by the combined use of artificials; the plant-food supplied by the latter will thus reduce or altogether abolish the necessity of utilizing the soil humus as a means of providing supplies of nitrogen, phosphates and potash.

It may be suggested that, in view of the limited supplies of cows' manure and oil-cakes available in India, more strenuous efforts should be made to extend the use of green manures throughout the country; much experimental work has been done on this subject, and in many parts of India the value of the method is well enough known to ensure its use, but the fact remains that over a large proportion of the arable area it is only occasionally practised. Several reasons exist for this failure to make use of such a valuable method of upkeep of soil fertility, one being the necessary loss of crop and another the frequent failure to obtain any obvious advantage from its use. It may be suggested that the methods of securing freedom from such failures which have been worked out in various districts should be given wider publicity and added to by further investigation: it may be noted here that one of these, well authenticated in Behar, is the use of superphosphate in conjunction with the burial of the green crop; this is an instance of the high value of an artificial fertilizer in Indian agricultural practice and leads to the conclusion that there is no justification for the old established opinion that imported fertilizers can find no useful application for ryot's crops in this country. In any case it is important in the interest of the conservation of the soil humus that every effort should be made to introduce the practice of green-manuring

wherever this is at present not in regular use, and that experiments should be carried out to ascertain the best methods of effecting this. It may be well to point out the advantages attaching to this use of cow manure or oil-cake; the first method involves no capital expenditure, which, even in the case of cow manure, is almost invariably required; supplies of cowdung and oil-cake are not always available, nor would they ever be sufficient to meet the requirements of the whole country even if the former were not mostly consumed as fuel. The introduction of a green leguminous crop in the rotation not only serves as a partial fallow but helps to eradicate undesirable weeds. All these reasons in favour of the use of green manuring are well known to officers of the Agricultural Department and are only mentioned here to emphasize the importance of the original equally well recognized theorem at the beginning of this paper in view of the dangerous tendency to neglect the destructive effects of excessive cultivation upon the humus content of Indian soils.

Farmers in all countries hold certain opinions based upon experience and tradition rather than upon scientific knowledge or reasoning. Among such opinions no one holds a firmer or more universally agreed upon position than that which assigns to organic nitrogen a value considerably in advance of that with which its inorganic salts are credited. Experiments such as those carried out at Rothamsted on mangolds between 1876 and 1902 completely justify this attitude of mind so far as it applies to the substitution of inorganic or organic nitrogen, but also show, as Hall points out, that the effects are due not to any intrinsic difference in the form of the nitrogen supplied, but to the maintenance of the stock of humus in the soil associated with the use of organic nitrogenous manures. It is quite clear that to secure and maintain a condition of tilth in the seed-bed suitable for the early stages of the growth of the seedling crop is of vital importance in India even more than in Europe, owing especially to the stringent conditions associated in this country with the supply of moisture to the young plant. This suitable condition of physical texture can only be secured in the presence of adequate supplies of soil humus, which intensive cultivation sooner or later will inevitably reduce below the requisite level.

The object of this paper, therefore, is not only to urge the necessity of realizing the prime importance of organic matter in Indian soils, but to point out that the very generally inadequate supplies of this constituent are in danger of depletion, as a result of the introduction and recommendation of cultivation methods which increase the rate of its oxidation and general consumption; this method of obtaining increased fertility at the expense of the humus content of the soil is unsound in as much as it

involves the utilization of this important constituent for the dual purpose, whereas part of this could be better fulfilled by the use of fertilizers, leaving the organic matter to carry out that function which it alone can perform by securing suitable mechanical texture in the soil. The practical interpretation of this argument lies in working out in the field suitable methods of combining the use of organic and inorganic manures, in such a way as to extend the existing supplies of the former over large areas by their partial substitutions by the latter. At the same time those fertilizers can be used to furnish part of the supplies of available plant-food now being obtained by natural but wasteful processes, through the medium of cultivation and tillage.—*The Tropical Agriculturist*, Vol. LXX, No. 1.

The Practical Applications of Meteorology to Agriculture.

The progress attained since the war, in the technique and distribution of weather forecasts, and in the use of meteorological apparatus adapted to agricultural needs has convinced the rural population of the advantages which they can derive from the two principal branches of meteorology, weather forecasting and climatology.

Since its formation in 1921, the French National Meteorological Office has seen each year a growth in the demand for information on the part of agriculturists and meteorologists and is in a fair way towards realization. Meteorologists now know exactly what is required by agriculturists who in their turn know more precisely what they may expect from meteorological science.

Weather Forecasts.

Principles of Weather Forecasts.—Foreknowledge of the weather of to-morrow and the following days is of the utmost interest to the farmer, especially in certain seasons. The question of weather forecasting has occupied the attention of agricultural circles from remote times, though it was not until the second half of the nineteenth century that it was solved scientifically. In 1857, the French astronomer, Le Verrier, concluded that it would be possible from daily meteorological charts, to predict some hours in advance the arrival of atmospheric disturbances, and, in consequence, probable changes in weather. The principle of scientific forecasting of weather has made much progress since that time. Wireless in particular has allowed the construction of more complete charts through rapid centralization of observations, not merely from the whole of Europe and Northern Africa, but from ships at sea, especially those in the Atlantic. This last information has the immense advantage of giving information of

the arrival of disturbances from the Atlantic, to which France is specially exposed by reason of its geographical situation on the west of Europe. There were three principal stages in the successive improvement of the technique of weather forecasting :—

Upto 1914, forecasts were based almost exclusively on the examination of isobar charts. These charts show the zones in which pressure decreases from the outside to the centre depression or increases from the outside to the centre anticyclone. The track of depressions or anticyclones can be followed on charts drawn up every twelve hours ; their position 24 hours later can be deduced, and in consequence, the weather they will bring to the district under consideration can be forecast. These deductions, unfortunately, are not always correct. The movement of depressions which, in general, takes place from west to east, is not always very regular. The track curls and turns back, the speed is variable and, like that of anticyclones, the track is influenced by many factors. It is the resultant of all these factors which determines the movement of pressure centres and the difficulty of forecasting will, therefore, be understood.

During the war, this method was improved by adding to it the method of barometric variations. There are drawn on charts, lines of equal variations, that is to say, lines passing through all the points at which barometric pressure has varied to the same extent during the determined period. These lines show zones of increase or decrease and their track is much more regular than that of depressions or anticyclones which they accompany and their speed is fairly constant in each season. A study of their evolution furnishes valuable indications for the forecasting of isobar situations.

There is a striking connection between the zones of variation of pressure and cloud systems. The study of cloud systems is the latest improvement made in the meteorological services of France for weather forecasting. If cloud charts are drawn up, it is seen that clouds are grouped in large extended masses which are well organized and move in a system known as the cloud system which has four parts : a front composed of high clouds partly covering the sky. This first part heralds the approach of a zone of low pressure. A centre formed by a uniform veil of clouds of average height accompanied by low clouds giving continuous rain. This centre coincides with the zone of low pressure itself. A tail with the sky alternately almost clear and very cloudy from the debris of clouds at all heights, giving a succession of showers, storms and fine weather. This tail accompanies the arrival of the zone of high pressure. On the borders of this system, there are margins in which there are only high or average clouds. Cloud systems move most often in a series

coming from the south-west, from the west or from the north-west. In the interval between two cloud systems the sky is clear or has local clouds which appear in the morning and disappear at night, but continuous fine weather is only experienced in general in zones of high pressure which are not touched by zones of variations.

It is by the combined study of isobar charts, charts of variation in pressure and charts of cloud systems that rational forecasts of weather can be made.

Distribution of Agricultural Warnings by Wireless.—Once these weather forecasts are made out, they must be brought to the notice of agriculturists as quickly as possible. Great progress was made in this direction in 1922 when the National Meteorological Office began to distribute its bulletin four times a day by wireless from the Diffel Tower. These warnings contain for each of the 12 regions into which France has been divided for the purpose, information on the general character of the weather, wind, rainfall, temperature, and the possibility of dangerous phenomena for agriculture such as frosts, storms, hail, etc.

Since August 1927, a further improvement has been introduced into the distribution of these agricultural warnings. The Compaigne Francaise De Radiaphonie decided to issue each day at 7 p.m., an agricultural meteorological communique specially adapted to the needs of farmers in the north of France and in the neighbourhood of Paris. This communique is drawn up by a group of agricultural experts and practical agriculturists with a high reputation in agricultural circles. They are in daily contact with the forecast service of the National Meteorological Office, and are thus kept in touch with all modifications in the weather situation revealed by the charts mentioned above. Being in full possession of all the facts, they can make such comment on the forecasts drawn up by the National Meteorological Office as will be of use to the rural population, and draw conclusions enabling the latter to employ their time to the best advantage on the morrow, *e.g.*, in cultivation, ploughing, manure-spreading, irrigation, harvesting, etc. The commentators also report on the need for preventive treatment when the atmospheric conditions are favourable to the development of fungus diseases or for prospective treatment when there is a likelihood of frosts, or for increasing the dressings of certain manures to counteract excessive humidity or drought ; the commentators also give advice of a more general kind adapted to the climate of each region, for example, the use of a certain variety of wheat or the possibilities of a catch crop. In short, they give agriculturists, in an assimilable form, the means of drawing the maximum profit from the weather forecasts of the National Meteorological Office.

This innovation could not have been better received in rural circles, and it is hoped, as a result of this initial success, that it will not be long before the regional stations of the National Meteorological Office are provided with sufficient staff and material to enable them to participate in this service. Farmers in all parts of France could thus benefit from communiques specially drawn up for their respective regions by meteorologists who know the local climatology well, and who work in the closest collaboration with practical agriculturists of the country.

Climatology.

(*a*) *General Application of Climatology in the Improvement of Crops.*—Weather forecasting is not, as generally thought, the only branch of meteorology which can be useful to agriculturists. There is a second—Climatology, of which many agriculturists are unaware, which can, however, render them considerable service. A precise knowledge of climate, that is to say, of the meteorological elements not solely of the air in which we live but of the air at the surface of the soil and in the soil, can play a capital part in agriculture for the following reasons :—

1. It will help to increase yields by facilitating the choice of varieties of crops best adapted to the climate ; varieties resistant to cold in the east, or drought in the south ; early varieties in regions where the heat of July causes "burning" to be feared ; varieties of which the critical periods (earing of cereals, for example) coincide to the maximum of probability with favourable meteorological phenomena.

2. It affords a powerful aid in the application of preventive treatment against fungus diseases. Two kinds of conditions are needed for the development of these diseases, those favourable for the fungus and those predisposing the plant to disease. High temperatures, drought and a high exposure to sunlight are factors propitious to fungi attacking the plant, which is already weakened by a partial withering of its tissues ; they form, on the contrary, a powerful obstacle to the development of the propagative organs of the fungus whose existence they menace. On the other hand, a soft and humid weather favourable to the fungus produces the maximum of turgescence in the tissues of the plant which is thus better able to resist fungus attack. In order to produce an epidemic it is necessary that these two opposite kinds of conditions must immediately succeed each other leading, in the first place, to pre-disposition of the plant to attack, and then to the development of the fungus before the plant can react. Thus at the beginning of the warm weather the plant withers in the day time ; now if, in the course of the night, temperature is lower and a mist is produced (an element propitious for the propagation of

fungus spores) the fungus attacks the plants, which will not have had time sufficiently to regain their turgescence and the epidemic will break out. On the basis of these data and from the observation that potato blight always travels from west to east, one can, in certain conditions of temperature and humidity and with observation posts judiciously placed, announce the probable advance of this disease in a given region and advocate the necessary preventive treatment.

3. It will sometimes allow measures to be employed to counteract certain atmospheric phenomena which are particularly dangerous at certain times of the year—use of artificial clouds against spring frosts, formation of societies intended to prevent or insure against hail.

4. It will assist the rational use of manures. It is known, for example, that lack of water in arable soil impedes nitrification. In very dry regions the extensive use of easily soluble manures may remedy this to a certain extent. In districts with abundant rainfall, where fungus diseases and storms are particularly to be feared, dressings of potassic and phosphatic manures will be increased. These same manures will induce vegetative activity in regions where winter cold and spring frosts lead to the risk of damage to advanced crops. The climatology of the country will be also utilized to fix the dates of spreading manures; for example, the application of potassic manures will be the earlier the drier the climate, that of nitrogenous manures on grass will be carried out as far as possible on dry days at the end of February when rain is imminent. Liming and marling will be done in the dry periods of autumn.

5. It is indispensable when new crops are tried. Thus in France, an increase in the area under sugar beet is very desirable. Before this crop is grown in certain departments, their climatology must be known, in particular, whether the distribution of average quantities of rain over the summer months will permit of the advantageous acclimatization of this crop. Sugar is produced as much through the water in the soil as from the carbonic acid in the air. Evaporation from the leaves of beet is considerable, and may reach 350,000 to 500,000 gallons of water per acre, corresponding to a rainfall of about 20 inches, which must be spread over half a year in May to October. It must be ascertained, therefore, that the rainfall can satisfy the need of this crop for water.

6. Finally, certain meteorological data can be instanced which are of service to agriculturists, *e.g.*, the monthly and annual distribution of rainfall and the amount of maximum falls, in the case of the construction of cisterns; the system of winds in the case of the installation of a mill or an air-wheel; and extremes of temperature, duration of frosts and their intensity, in the case of heating in glass-houses,

(*b*) *Study of a particular Climatological Factor, e.g., Influence of Rain in Agriculture.*—Among the climatological phenomena having an important effect on agricultural production, rainfall seems to take first place, and it seems useful by way of example to study, in some detail, the rôle of rainfall on agriculture. The amount of rainfall is expressed in inches, a precipitation of 1 inch corresponding to 4.7 gallons of water, *i.e.*, 47 lbs. per square yard, *i.e.*, 22,500 gallons per acre. In France, the average quantity of rain received annually varies according to district, the minimum in the neighbourhood of Paris and the maximum in the neighbourhood of the mountains.

Fertilizing Effects of Rainfall.—The physical and chemical effects of rainfall are well known. Minerals in the soil are rendered soluble without which they cannot be utilized for the formation of plant tissues. It is, also, through rainfall that fermentation indispensable to plant life takes place in the soil. There is one point to which particular attention must be called, namely, the fertilizing effect of rainfall due to the ammoniacal or nitric nitrogen which it contains in quantities far from negligible. Determinations carried out in France and Belgium have shown that rain contains, on the average, .00002 per cent of ammoniacal nitrogen and .00007 per cent of nitric nitrogen. Winter rainfall is, in general, richer in nitrogen than summer rainfall. It is seen that rain brings in an average year some 13 lbs. of nitrogen per acre in the region of Paris and more than 26 lbs. in the wetter districts of the country. In Germany and in Italy the average quantity of nitrogen brought per acre by rainfall has been found to be about 10 lbs. and in England about 7 lbs. of which three-quarters are ammoniacal nitrogen and one-quarter nitric nitrogen, while in the United States it is as large as 20 lbs. of which 13 lbs. are ammoniacal nitrogen and 7 lbs. nitric nitrogen. Rainfall is about 10 times richer in nitrates in tropical regions than in temperate climates. The proportion of ammonia is also much higher, which explains the luxuriant vegetation on certain African soils which, from their composition, would be considered as poor. These quantities of nitrogen furnished by rain are much superior to those given in manures, especially in France.

Thus, in some degree, rainfall supplies manure, but the reverse is sometimes the case, and manure can, at least in part, replace water. In order, for example, in the case of wheat, for the plant to manufacture 1 gr. of dry matter it has been established that 0.53 pints of water are necessary in unmanured soil and only 0.35 pints in the same soil with average manurial dressings. The transpiration of cereals is, in fact, diminished by the use of manures, and, varying with the dressing of the latter and the nature of the soil and the quantity of water required to produce 33 bushels

of wheat per acre, weighing 71 lbs. per bushel, has been reduced from 24 inches to 8 inches.

Disadvantages of Excessive Rainfall.—Potash salts are retained by the absorptive power of the soil and suffer only insignificant losses from rainfall. No loss is to be feared so far as concerns soluble phosphatic manures. It is different, however, with nitrates which are in danger of being lost in drainage water through abundant rainfall in autumn and rainfall in autumn and winter. This point must, however, not be exaggerated. The loss of nitrates in the subsoil is much less rapid than is often imagined; thus after a rainfall of half an inch it was found that nitrates only descended a few tenths of an inch in the soil, while the humidity produced by this rain falling on a dry soil had penetrated in one day to $2\frac{1}{2}$ inches. Further, in warm weather nitrates may be brought back quite quickly by capillarity from a considerable depth to the surface. Nitrate 10 inches deep in the soil was thus returned to the surface in a fortnight. During this season, capillarity causes the water in the soil to rise to replace that lost in evaporation. This water brings with it dissolved products deep in the soil, products which thus come to be concentrated in the neighbourhood of the roots of plants. Too deep a burying of nitrates following rain need not be feared when the manures are applied in spring even if they are ploughed or harrowed in. As, however, nitrates are subject to denitrification in every humid soil, it is advisable, where too heavy rains or high humidity are to be feared, to replace nitrates by ammoniacal manures. Sulphur and, above all, lime are lost through rainfall in larger quantities than any other manurial element. Losses of lime, naturally more important in a rainy climate than in a dry district, attain on the average in France 3 to 4 cwt. per acre per annum; in very rainy years they have even reached $4\frac{3}{4}$ cwt. The practice of liming is, therefore, absolutely necessary, as lime is an indispensable element in the nutrition of plants equally with nitrogen, phosphoric acid and potash.

Soils which are too wet, *i.e.*, which contain more than 40 per cent of their weight of water, are in general impermeable to air, and thus any gaseous exchange between the soil and the atmosphere is rendered impossible. There results a stoppage of respiration of plant roots, leading to asphyxiation of the plants and lowering of the temperature of the soil harmful to their growth. The water which is a bad conductor of heat remaining in the top layers of the soil is not replaced by air and in consequence, these layers, although superficially warm in spring, cannot transmit this warmth to the lower layers which remain cold. There results, among other things from this lack of warmth, the impossibility of

production of carbonic acid gas in the soil and an indispensable element in the development of the plant as a complement of carbonic acid gas in the atmosphere. Soils which are too wet lack air and are cold, but it is possible by drainage to aerate and warm them. Experiments have shown that the average temperature of a drained soil can be 6 degrees C. higher than that of an undrained soil.

The substances necessary for the nutrition of plants, concentrated in the neighbourhood of the root hairs, penetrate these latter with the soil water by capillarity and endosmosis and ascend through the plant cells under the impulse of these forces. Their ascension and their absorption are considerably increased by transpiration, which leads to the consumption of an enormous quantity of water compared with that strictly necessary for the tissues. Thus fertilizing elements from the soil reach right to the leaves. If the soil is too dry, transpiration is greater than absorption and plants wither, but if the soil is saturated, the plants are " gorged " with water and their vegetative apparatus is developed to the detriment of their reproductive apparatus. In this latter case, in effect, the substances in the soil are diluted to too large a degree with liquid and, since the roots can only absorb a certain volume of water, the plants are deprived of a certain amount of their nutrients, notably phosphates, without which it is impossible for them to live normally. On the other hand, they have other nutrients at their disposal in greater quantity particularly nitrogen brought down in the rainfall. There results an exaggerated growth of the vegetative organs, a diminution of precocity and a marked tendency to the invasion of fungus parasites. This can be remedied by increasing the phosphatic dressings.

The year 1927 showed once more that while abundant summer rain has not always a bad effect on the quantity, it has on the quality of the crop. For wheat, in particular, it has been established that rain at harvest does not lead to the germination of the grain in the sheaf unless accompanied by a sharp fall in temperature such as is produced at the time of a storm. Such fall of temperature is not an obstacle to germination as one would be tempted to think, but, on the contrary, the determining cause. The damage to the crop is the greater the longer the temperature remains below the normal after rainfall, and inversely the damage is the smaller the more rapidly the thermometer regains the average for the season. In regions where rainfall is abundant during the months of July and August, it is to the interest of farmers to select varieties of wheat which are resistant to this special effect of summer rains.

Correlation between Rainfall and the Yield of Wheat.—The preceding considerations show the important part played in agriculture by rainfall.

It has long been known, it is found for instance in the Bible, that harvests are intimately dependent on rainfall. For the central region of France in particular, the following rules have been drawn up on the relation between rainfall in the quarter April, May, June, and the yield of the wheat crop :—

(1) If the rainfall during these three months is below average, the yield will be above average so long as the temperature is not more than 1 degree C. above the average. If the temperature is more than 1 degree C. above average, the crop is damaged by burning.

(2) If the rainfall during these three months is above average, the yield of wheat is below average.

Analogous conditions have been found in the north of Italy and in Ohio where a diminution of rain in the spring is accompanied by an increase in the yield of wheat. On the contrary, in the south of France and the southern part of the Italian Peninsula, the effect of rainfall is quite the opposite.

Radio Meteorological Installation of an Agricultural Holding.

The preceding considerations suffice to show the importance for the agriculturist on the one hand of the reception of short term weather forecasts, and on the other of a knowledge of climatological elements not only for his region, but also for the precise spot where his holding is. He can thus take account of the repercussion of atmospheric factors on his crops and seek for means to diminish the disastrous effects of certain of them.

It is indispensable in the first place that wireless receiving sets should be multiplied in country districts, for agriculturists can thus receive beside the regional weather forecasts sent out each day at a fixed hour, special warnings of atmospheric conditions favourable to the development of fungus diseases, of spring frosts, or of particularly violent hailstorms.

In the next place, every important holding should have besides a barometer, the variations of which will complete the forecast data, a small meteorological installation comprising several simple pieces of apparatus which stand rough usage, which cost little, and which give sufficiently precise data. Until 1927 such instruments did not exist. This regrettable gap has now been filled by the National Meteorological Office on the demand of a seed selection society in the Paris district which desired to possess a meteorological station, and at the present time agricultural meteorological posts, on that Office's model are being multiplied throughout the country. The installation comprises :—

(1) A screen of very small dimensions containing maximum and minimum thermometer, psychrometer and evaporimeter.

(2) A rain gauge.

(3) An actinometer for the determination of the intensity of solar radiation and sunshine recorder.

(4) An outside evaporimeter to determine evaporation at the level of the plant.

(5) A maximum and minimum thermometer placed a few centimetres above the soil in order to obtain the temperature at the soil level.

(6) A soil thermometer to measure the temperature at 40 cms. depth.

(7) Three special soil thermometers to determine the temperature of the soil at depths of 30 cms., 60 cms., and 1 metre.

The whole of this apparatus costs about 1,500 francs but for many agriculturists a smaller installation would be sufficient; that employed in the Department of Seine-et-Oise, with the collaboration of the Meteorological Commission of that Department may be instanced as especially interesting. On a dozen holdings there has been installed a Meteorological "Post" comprising only a rain-gauge, outside evaporimeter, maximum and minimum thermometer to measure the temperature of the open air at a few centimetres above the ground, and a soil thermometer at 40 cms. depth, a Meteorological post, composed of these four pieces of apparatus, gives very complete information on the temperature of the air and the soil in the layers affecting plants, as well as of rainfall and evaporation which are two phenomena which ought not to be separated.

The price is only 200 francs, since rain gauges are generally lent free by the Departmental Meteorological Commissions to persons who express the wish to have them, the only condition imposed being that they undertake to carry out observations regularly every day and forward a summary every month.—*Journal of the Ministry of Agriculture*, Vol. XXXV, No. 7.

The Mysore Agricultural and Experimental Union.

Programme of Experimental Work for 1929.

CIRCULAR.

The Department of Agriculture desires to arrange with members of the Mysore Agricultural and Experimental Union for the carrying out of the experiments mentioned below. Members intending to undertake experimental work are requested to apply to the Secretary, the Mysore Agricultural and Experimental Union, Seshadri Road, Bangalore, before the end of the month marking out the experiment or experiments they desire to undertake on this circular itself. The seed, manure, etc., will be supplied in the order in which the application is received as long as the stock lasts.

1.--Experiments with Implements.

Trial of the "Mysore" and "Bangalore" ploughs manufactured by the Cooper Engineering Works, Satara, in comparison with the Kolar Mission plough and "Mysore" plough manufactured by Messrs. Ransomes Jeffreys & Co., England. Only such members as are already using either the Kolar Mission or the Mysore plough, or both, need apply for the trial of the new ploughs. The new plough will be sent to intending experimenters on the understanding that—

(*a*) It shall be used through one ploughing season and shall be used for ploughing not less than 5 acres of land;

(*b*) It shall be returned to the Department at the end of the ploughing season with a report as to its working in the prescribed form.

(*c*) Members undertaking the trial will please state what kind of improved ploughs they are using at present.

Conveyance charges to and from the members' places will be borne by the Department.

2.—Experiments with Seeds.

Trial of selected strains of—

(*a*) Ragi—seed enough for 3 guntas each of two new varieties will be supplied.

(*b*) Groundnut—seed enough for 3 guntas each of one or two new varieties will be supplied.

(*c*) Cotton :

(1) Doddahatti—seed enough for 3 guntas will be supplied.

(2) Sannahatti—seed enough for 12 guntas each of two varieties will be supplied.

Trials confined to cotton areas only.

(*d*) Paddy—seed enough for 3 guntas each of any two varieties will be supplied.

(*e*) Sugarcane—seed enough for one gunta each of two Hebbal seedling canes will be supplied. Arrangements for the conveyance of seed setts from the nearest railway station should be made by the member indenting for them. Applications for sugarcane setts should be made so as to reach the Secretary before the end of the month.

Conditions of Supply of Seed.

1. The seed of each variety shall be sown in separate plots with check plots arranged as per instructions sent with the seed.
2. The results of experiments shall be reported after harvest in the form which will be supplied.
3. The experiments shall be conducted continuously for at least three years, seeds for the second and subsequent sowings being reserved from the first supply by the Agricultural Department.

3.—Experiments with Manures.

I. Sugarcane—Comparative trial of 80 lbs. of ammonium sulphate and 3 cwts. of superphosphate per acre applied before planting and 160 lbs. of sulphate applied again about 10 weeks after planting, against—

1. Only 3 cwts. of super at planting and 240 lbs. of sulphate about 10 weeks after planting, *or*
2. 100 lbs. of Ammophos 13–48 grade at planting and 160 lbs. of sulphate of ammonia 10 weeks after planting, *or*
3. 100 lbs. Diammonphos 20–53 grade at planting and 160 lbs. of sulphate of ammonia 10 weeks later on.

Not less than 10 guntas of land will be required.

II. Paddy.—Trial of 250 lbs. of groundnut cake and 1½ cwts. of super per acre against—

(*a*) 100 lbs. Ammophos 20–20 grade, *or*

(*b*) 100 lbs. Leunaphos, *or*

(*c*) 100 lbs. Diammonphos 20–53 grade.

Not less than 10 guntas of land will be required.

4.—Experiments on the Control of Insect Pests.

(*a*) Sugarcane Borer.
(*b*) Pests of Stored Pulses.
(*c*) Coffee Borer.
(*d*) Cardamom Caterpillar.
(*e*) Lime-tree Borer.
(*f*) Avare Pod Borer.

Printed instructions will be sent on requisition.

5.—Experiments on the Control of Fungus Diseases.

(*a*) Black Rot of Coffee.
(*b*) Treatment against Smut on Jola.

6.—Experiments on Fodder Conservation.

Use of sunflower, jola and other fodder crops for ensilage.

BANGALORE,
2—1—1929.

LESLIE C. COLEMAN,
President,
The Mysore Agricultural and Experimental Union.

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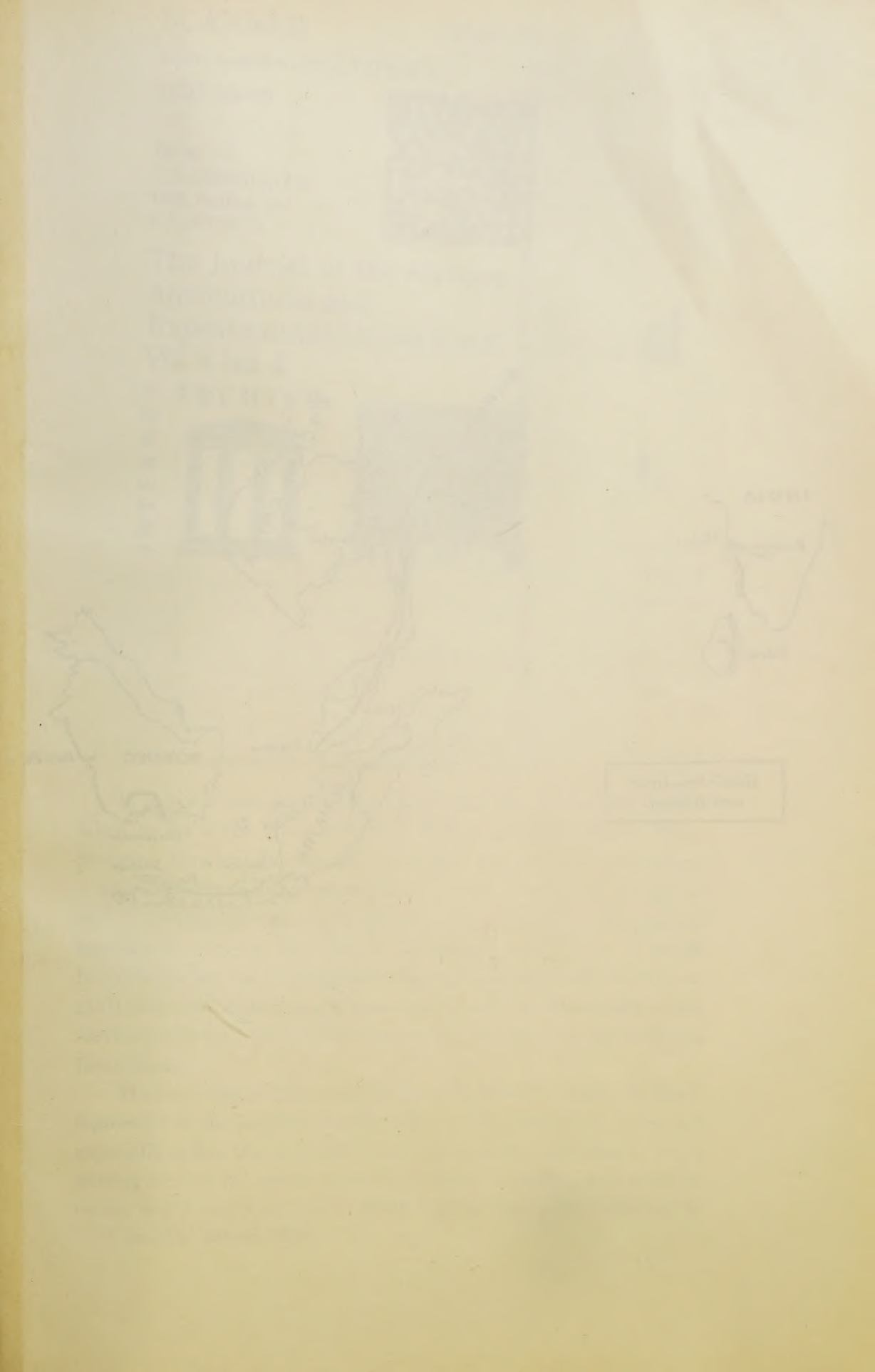

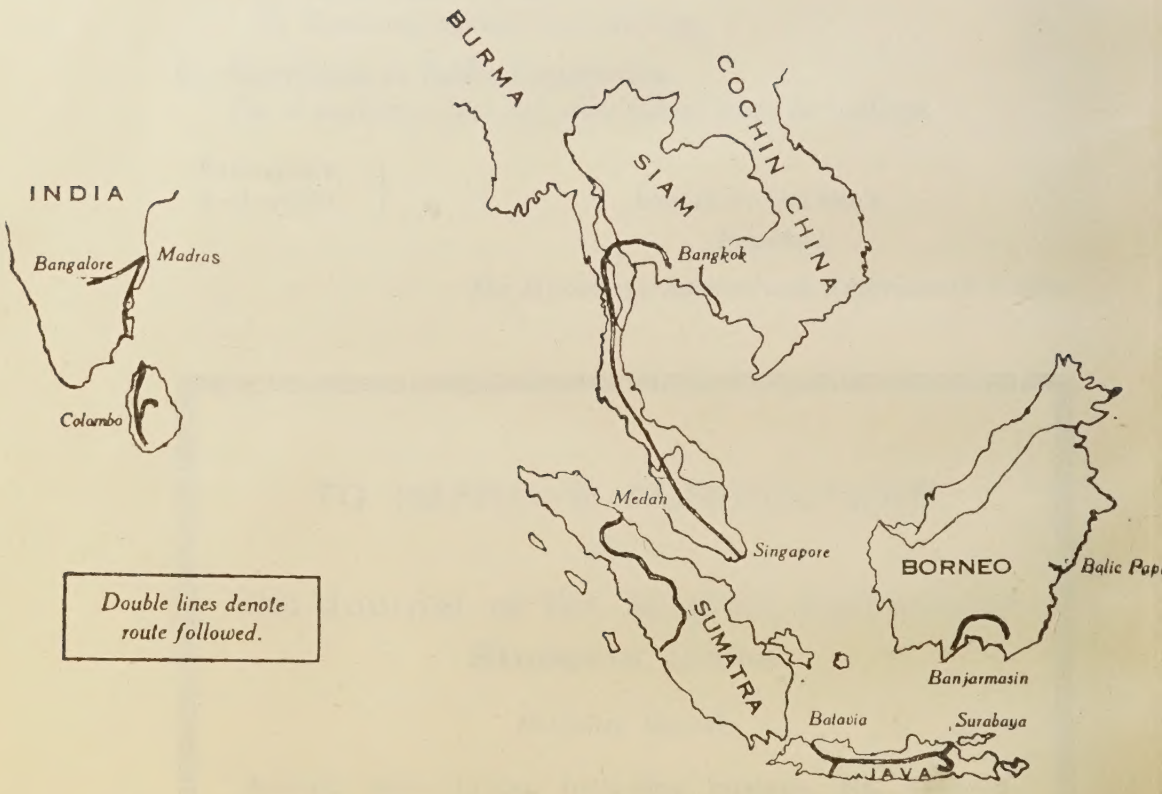
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